Measurement of RF Emissions from an OOK Door Sensor Transmitter

For	Chamberlain Group, Inc. 845 Larch Ave Elmhurst, IL 60126-2850
P.O. Number	4900043378
Date Tested	June 27- 30, 2017
Test Personnel	Tylar Jozefczyk
Test Specification	FCC "Code of Federal Regulations" Title 47 Part15, Subpart C Industry Canada RSS-Gen Industry Canada RSS-210

Test Report By:

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EMC Engineer

Requested By: Adil S Ahmed
Chamberlain Group, Inc.

Approved By:

Raymond J. Klouda
Registered Professional
Engineer of Illinois - 44894

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REVISION HISTORY

Revision	Date	Description
—	24 July 2017	Initial release

Measurement of RF Emissions from an OOK Door Sensor Transmitter

1. INTRODUCTION

1.1. Scope of Tests

This report presents the results of the RF emissions measurements performed on an OOK Door Sensor, (hereinafter referred to as the Equipment Under Test (EUT)). The EUT was designed to transmit at approximately 311.88MHZ, 312.5MHz, and 313.12MHz using an internal antenna. The EUT was manufactured and submitted for testing by Chamberlain Group, Inc. located in Elmhurst, IL.

1.2. Purpose

The test series was performed to determine if the EUT meets the conducted and radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.231 for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2014.

1.3. Deviations, Additions and Exclusions

There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4. EMC Laboratory Identification

This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by The American Association for Laboratory Accreditation (A2LA). A2LA Certificate Number: 1786.01.

1.5. Laboratory Conditions

The temperature at the time of the test was 25^{o}C and the relative humidity was 30%.

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2016

- ANSI C63.4-2014, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

- Industry Canada Radio Standards Specification, RSS-Gen, “General Requirements for Compliance of Radio Apparatus”, Issue 4, November 2014

- Industry Canada Radio Standards Specification, RSS-210, “License-Exempt Radio Apparatus: Category I Equipment”, Issue 9, August 2016

3. EUT SETUP AND OPERATION

3.1. General Description

The EUT is a Chamberlain Group, Inc. OOK Door Sensor. This sensor is attached to a garage door and works together with the garage door opener to allow the owner to monitor their garage doors, as well as open and close them through the use of a mobile application. The EUT also ensures the security of the garage door. It will send supervisory transmissions to the garage door opener to ensure the integrity of the system. It will also include the state of the door itself and the battery voltage of the transmitter in this transmission. A block diagram of the EUT setup is shown as Figure 1.

3.1.1. Power Input

The EUT was battery operated.

3.1.2. Peripheral Equipment

There was no peripheral equipment submitted with the EUT.

3.1.3. Signal Input/Output Leads

There were no interconnect cables submitted with the EUT.

3.1.4. Grounding

The EUT was ungrounded during the tests.

3.2. Operational Mode

For all tests the EUT and all peripheral equipment were placed on an 80cm high non-conductive stand. The EUT and all peripheral equipment were energized.

Tx - When powered up and switched between 'open' and 'close', the EUT will send out a full powered transmit signal for 4 seconds, followed by a less than 1 second transmission 40 seconds later. The EUT will then send out a transmission 30 minutes later and repeat that transmission until it is powered off.

It was programmed to continuously transmit three frequencies separately: 311.88MHZ, 312.5MHz, and 313.12MHz.

3.3. EUT Modifications

No modifications were required for compliance to FCC Title 47, Part 15, Subpart C, Section 15.231.

4. TEST FACILITY AND TEST INSTRUMENTATION

4.1. Shielded Enclosure

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. With the exception of the floor, the reflective surfaces of the shielded chamber are lined with ferrite tiles on the walls and ceiling. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

4.2. Test Instrumentation

The test instrumentation and auxiliary equipment used during the tests are listed in Table 9-1.

Conducted and radiated emission measurements were performed with a spectrum analyzer. This receiver allows measurements with the bandwidths and detector functions specified by the FCC. The receiver bandwidth was 120kHz for the 30MHz to 1000MHz radiated emissions data and 1MHz for the 1000MHz to 5000MHz radiated emissions data.

4.3. Calibration Traceability

Test equipment is maintained and calibrated on a regular basis with a calibration interval not greater than two years. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.4. Measurement Uncertainty

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

The measurement uncertainty for these tests is presented below:

Conducted Emissions Measurements		
Combined Standard Uncertainty	1.06	-1.06
Expanded Uncertainty (95% confidence)	2.12	-2.12

Radiated Emissions Measurements		
Combined Standard Uncertainty	2.09	-2.09
Expanded Uncertainty (95% confidence)	4.19	-4.19

5. TEST PROCEDURES

5.1. Periodic Operation Measurements

5.1.1. Requirements

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released. Also, a transmitter activated automatically shall cease transmission within 5 seconds after activation.

Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

5.1.2. Procedures

a) The spectrum analyzer was setup to display the time domain trace. The spectrum analyzer was used to record the amount of time that the EUT remained active following its activation.
b) The sweep time was then set for 10 seconds. The transmitter was manually activated and the trace recorded.
c) The sweep time was then set for 10 seconds. The wide transmission burst was measured and recorded.
d) The sweep time was then set for 75 seconds. The periodic transmission burst was measured and recorded.
e) The sweep time was then set for a 1 hour (3600s) test. The total number of periodic transmission bursts was summed.

5.1.3. Results

The plots for the periodic timing are shown on data pages 16 through 19. Data page 16 shows that the EUT ceases operation within the allotted 5 second time. Data pages 17 through 18 show the length of the transmission bursts. Finally, page 19 shows the total number of transmission bursts does not exceed the total transmission time of 2 seconds per hour. This complies with the requirement of periodic transmissions used in safety or security operations.

5.2. Duty Cycle Factor Measurements

5.2.1. Procedures

The duty cycle factor is used to convert peak detected readings to average readings. This factor is computed from the time domain trace of the pulse modulation signal.

The duty cycle factor was calculated from information supplied by the manufacturer. Since this EUT utilizes a

rolling code modulation, the duty is calculated based on the worst case. The following procedure was used to measure a representative sample:

a) With the transmitter set up to transmit for maximum pulse density, the time domain trace is displayed on the spectrum analyzer.

b) The pulse width is measured and a plot of this measurement is recorded.

c) Next the number of pulses in the word period is measured and a plot is recorded.

d) Finally the length of the word period is measured and a third plot is recorded. If the word period exceeds 100msec, the word period is limited to 100msec.

e) The pulse width and number of pulses for the word period are used to compute the on-time. The duty cycle is then computed as the (on-time/ word period).

f) The duty cycle factor is computed from the duty cycle.

5.2.2.Results

The plot of the duty cycles are shown on data pages 20 through 22. The manufacturer provided following information to calculate the duty cycle for the Rolling Code:

The rolling code consists of the following: 50 short pulses (0.246msec) and 18 long pulses (0.494msec).

A worst case situation is used when computing the rolling code modulation factor.

Worst Case = 21.2msec on-time over 100msec word period

Duty Cycle Factor = 20log (21.2/100) = -13.5dB.

Since the plots were made for the rolling code, the duty cycle factor shown on the plots may not show the worst case but was found to be no greater than the worst case duty cycle factor.

5.3. Radiated Measurements

5.3.1.Requirements

The EUT must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.231 et seq.

Fundamental Frequency MHz	Field Intensity uV/m @ 3 meters	Field Strength Harmonics and Spurious @ 3 meters
260 to 470	3,750 to 12,500*	375 to 1,250*

* - Linear Interpolation

In addition, emissions appearing in the Restricted Bands of Operation listed in paragraph 15.231(b) shall not exceed the general requirements shown in paragraph 15.231.

5.3.2.Procedures

All tests were performed in a 32ft. x 20ft. x 18ft. hybrid ferrite-tile/anechoic absorber lined test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall. The powerline filters prevent extraneous signals from entering the enclosure on these leads.

A preliminary radiated emissions test was performed to determine the emission characteristics of the EUT. For

the preliminary test, a broadband measuring antenna was positioned at a 3 meter distance from the EUT. The entire frequency range from 30MHz to 5.0GHz was investigated using a peak detector function. The data was then processed by the computer to calculate equivalent field intensity. * Replace with the proper frequency range.

The final open field emission tests were then manually performed over the frequency range of 30MHz to 4000MHz. Between 30MHz and 1000MHz, a tuned dipole antenna was used as the pick-up device. A broadband double ridged waveguide antenna was used as the pick-up device for all frequencies above 1GHz. All significant broadband and narrowband signals were measured and recorded. The peak detected levels were converted to average levels using a duty cycle factor which was computed from the pulse train.

To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

1) The EUT was set to transmit at 311.88MHz.
2) The EUT was rotated so that all of its sides were exposed to the receiving antenna.
3) Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
4) The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.
5) Steps (1) through (4) were repeated with the EUT set to transmit at 312.5MHz.
6) Steps (1) through (4) were repeated with the EUT set to transmit at 313.12MHz.

5.3.3.Results

The preliminary plots, with the EUT transmitting at 311.88MHZ, 312.5MHz, and 313.12MHz, are presented on data pages 23 and 34. The plots are presented for a reference only, and are not used to determine compliance.

The final open area radiated levels, with the EUT transmitting at 311.88MHZ, 312.5MHz, and 313.12MHz, are presented on data pages 35 through 37. As can be seen from the data, all emissions measured from the EUT were within the specification limits. The emissions level closet to the limit (worst case) occurred at 311.88MHZ, 312.5MHz, and 313.12MHz. The emissions level at this frequency was -2.3dB within the limit. Photographs of the test configuration which yielded the highest (or worst case) radiated emission levels are shown on Figures 2 and 3.

5.4. Occupied Bandwidth Measurements

5.4.1.Requirement

In accordance with paragraph 15.231(c), all emissions within 20dB of the peak amplitude level of the center frequency are required to be within a band less than 0.25% of the center frequency wide.

5.4.2.Procedures

The EUT was placed on an 80cm high non-conductive stand. The unit was set to transmit continuously. With an antenna positioned nearby, occupied bandwidth emissions were displayed on the spectrum analyzer. The resolution bandwidth was set to 30kHz and span was set to 2MHz. The frequency spectrum near the fundamental was plotted for all frequencies.

5.4.3.Results

The plot of the emissions near the fundamental frequency is presented on data pages 38 through 43. As can be seen from this data page, the transmitter met the occupied bandwidth requirements. The 99% bandwidth was measured to be 214.79kHz for 311.88MHZ, 294.71kHz for 312.5MHZ, and 329.67kHz for 313.12MHZ.

6. OTHER TEST CONDITIONS

6.1. Test Personnel and Witnesses

All tests were performed by qualified personnel from Elite Electronic Engineering Incorporated.

6.2. Disposition of the EUT

The EUT and all associated equipment were returned to Chamberlain Group, Inc. upon completion of the tests.

7. CONCLUSIONS

It was determined that the Chamberlain Group, Inc. OOK Door Sensor did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.231 et seq. for Intentional Radiators, when tested per ANSI C63.4-2014.

It was determined that the Chamberlain Group, Inc. OOK Door Sensor did fully meet the technical requirements of the Industry Canada Radio Standards Specification, Radio Standards Specification RSS-210 for transmitters, when tested per ANSI C63.4-2014.

8. CERTIFICATION

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUT at the test date. Any electrical or mechanical modification made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the Federal Government.

9. EQUIPMENT LIST

Table 9-1 Equipment List

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Due Date
CDX8	COMPUTER	ELITE	WORKSTATION			N/A	
NTA2	BILOG ANTENNA	TESEQ	6112D	28040	25-1000MHz	11/27/2016	11/27/2017
NWQ1	DOUBLE RIDGED WAVEGUIDE ANTENNA	ETS-LINDGREN	3117	66655	1GHZ-18GHZ	4/4/2016	4/4/2018
PHA0	MAGNETIC FIELD PROBE	ELECTRO-METRICS	EM-6882	134	22-230MHZ	NOTE 1	
RBG0	EMI ANALYZER	ROHDE & SCHWARZ	ESW44	101533	10HZ-44GHZ	11/10/2016	11/10/2017
WKA1	SOFTWARE, UNIVERSAL RCV EMI	ELITE	UNIV_RCV_EMI	1	---	I/O	

I/O: Initial Only
N/A: Not Applicable
Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.

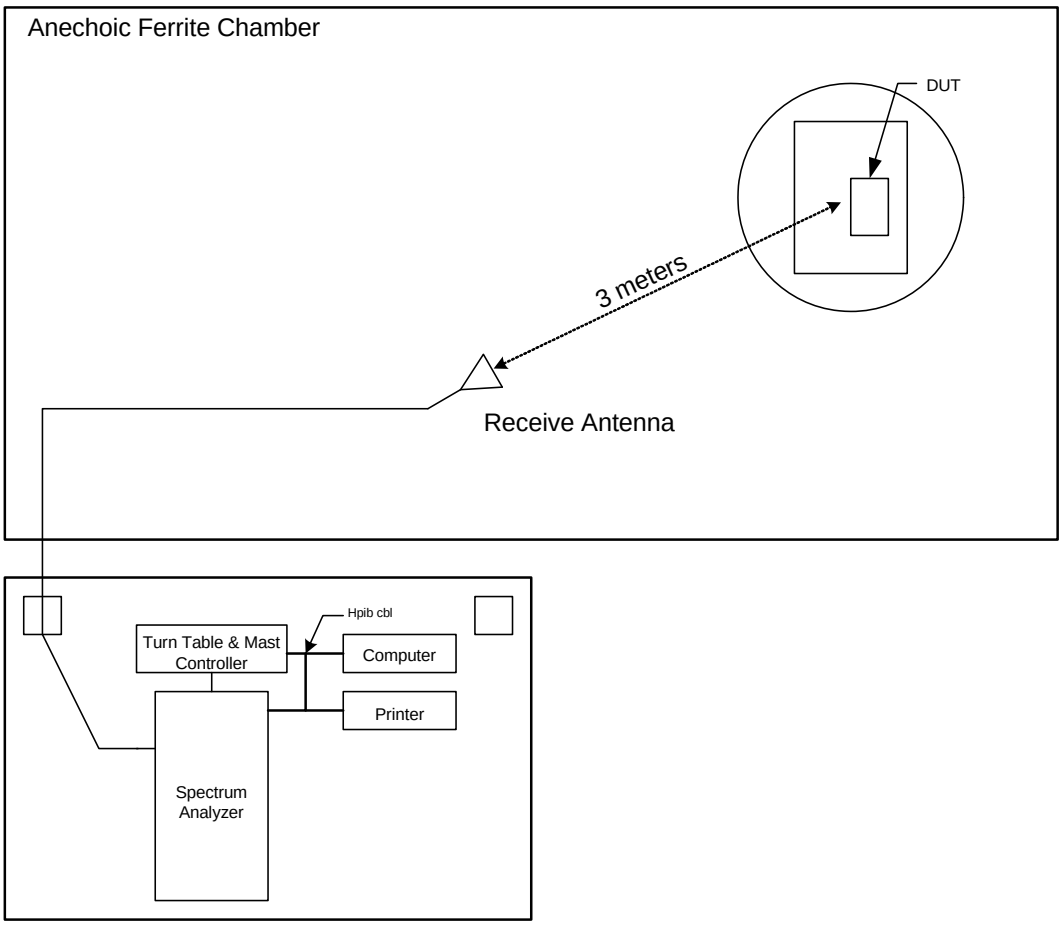


FIGURE 1 BLOCKDIAGRAM OF TEST SETUP

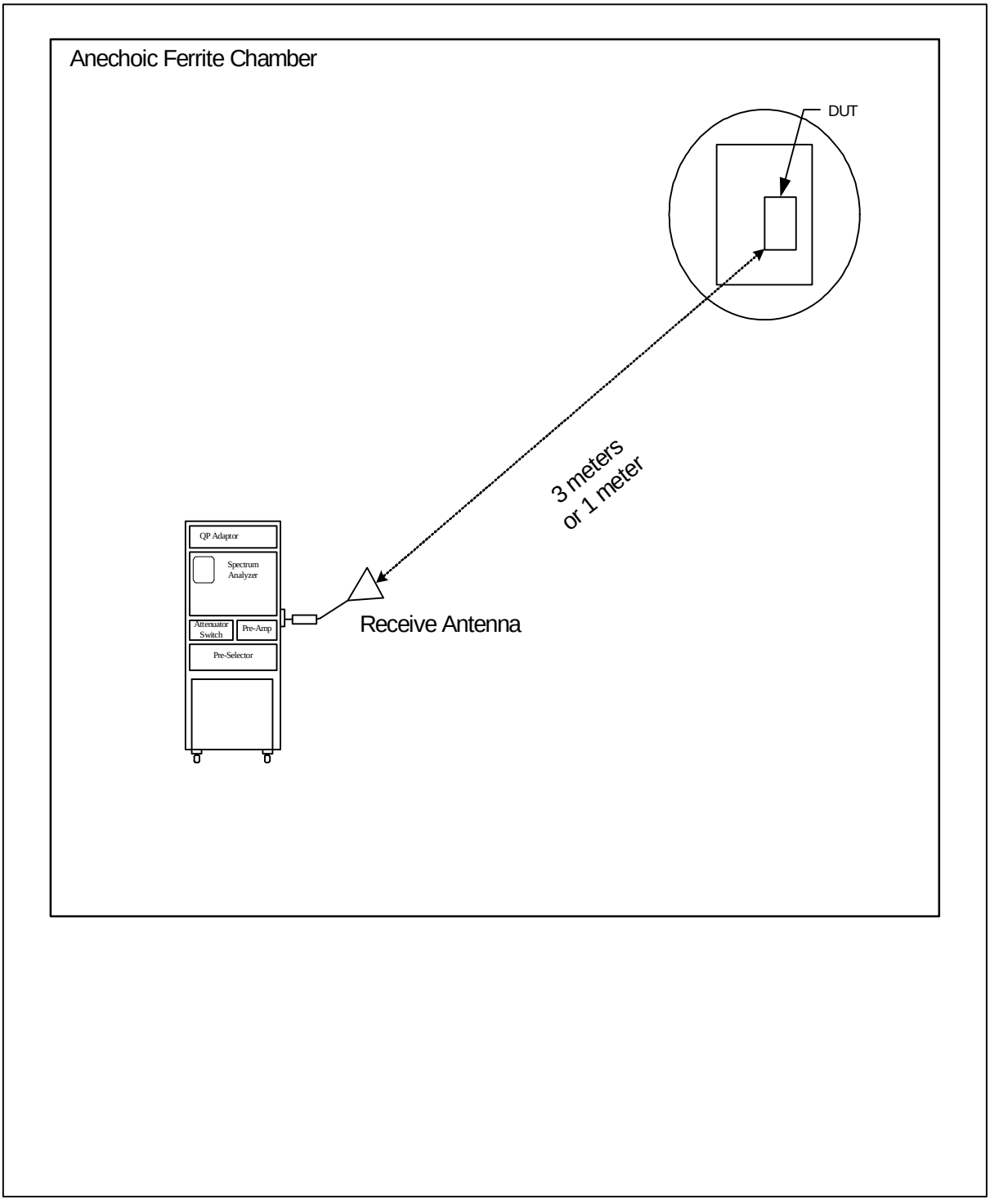
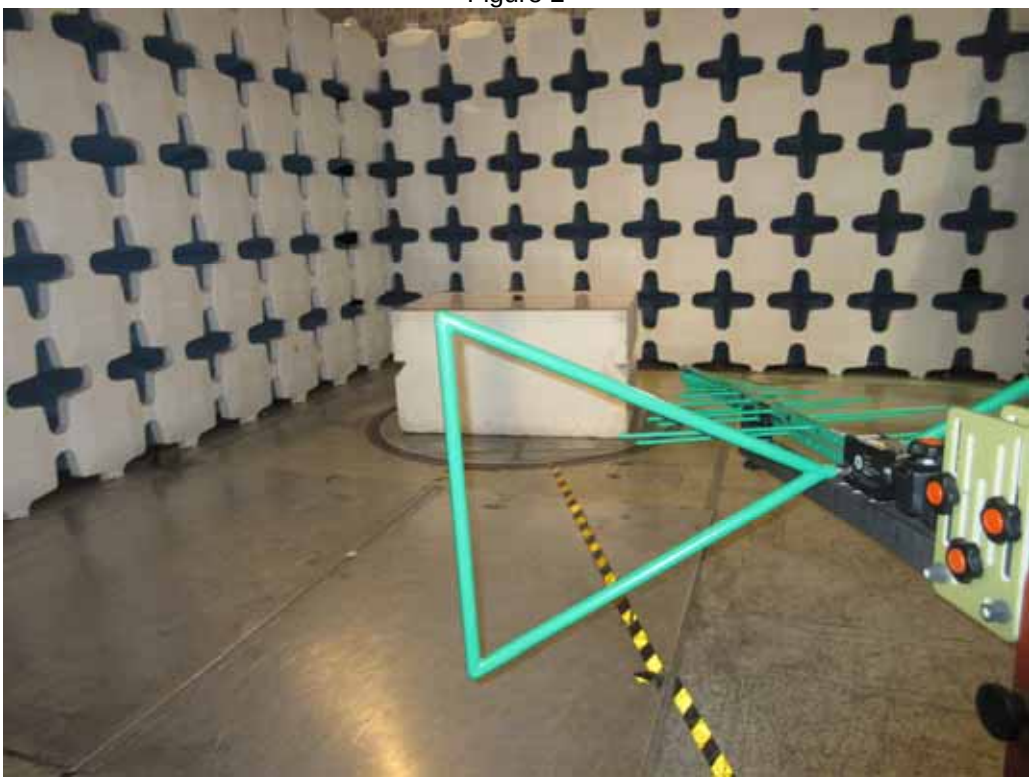

Anechoic Ferrite Chamber
DUT
3 meters
or 1 meter
QP Adaptor
Spectrum
Analyzer
Attenuator
Switch
Pre-Amp
Pre-Selector
Receive Antenna

Figure 2



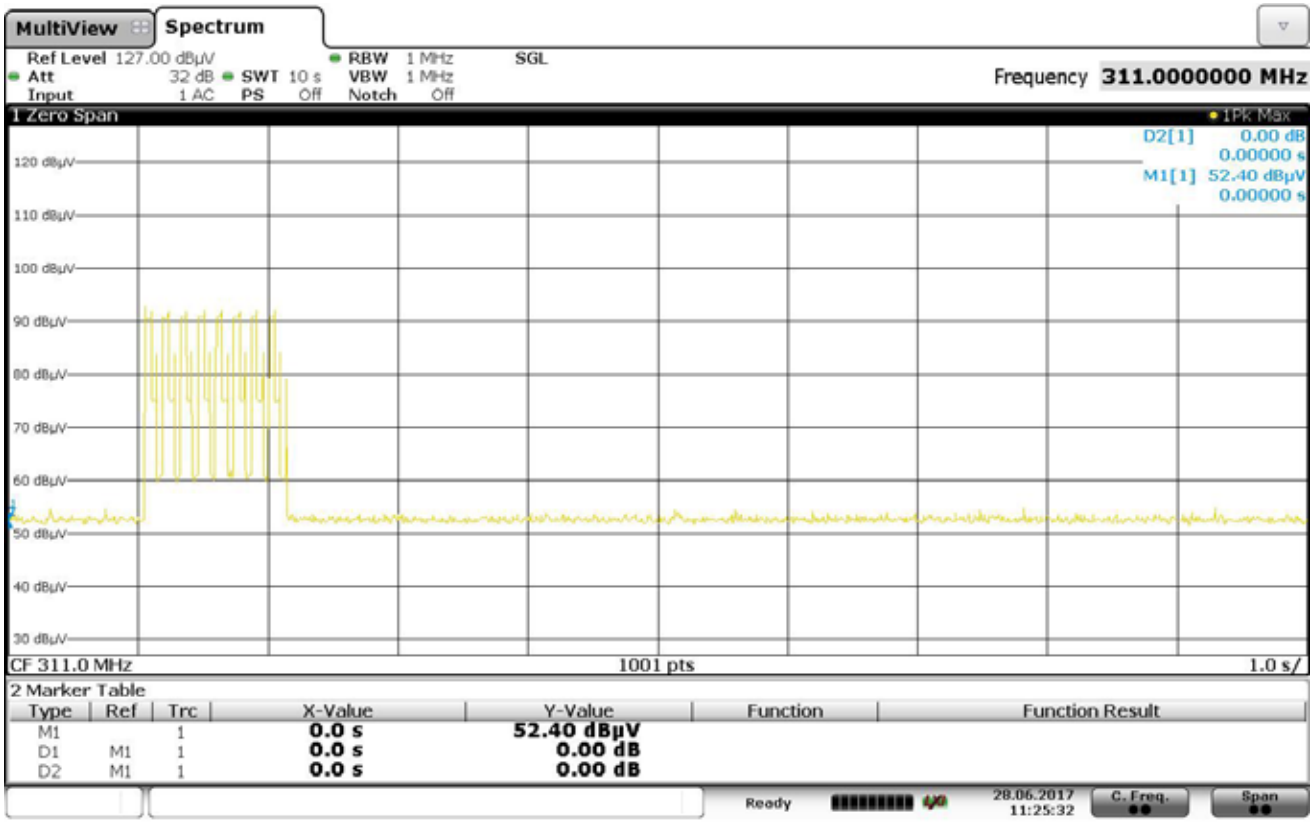
Test Setup for Radiated Emissions, 30MHz to 1GHz – Horizontal Polarization

Test Setup for Radiated Emissions, 30MHz to 1GHz – Vertical Polarization

Figure 3

Test Setup for Radiated Emissions, 1-4.5GHz – Horizontal Polarization

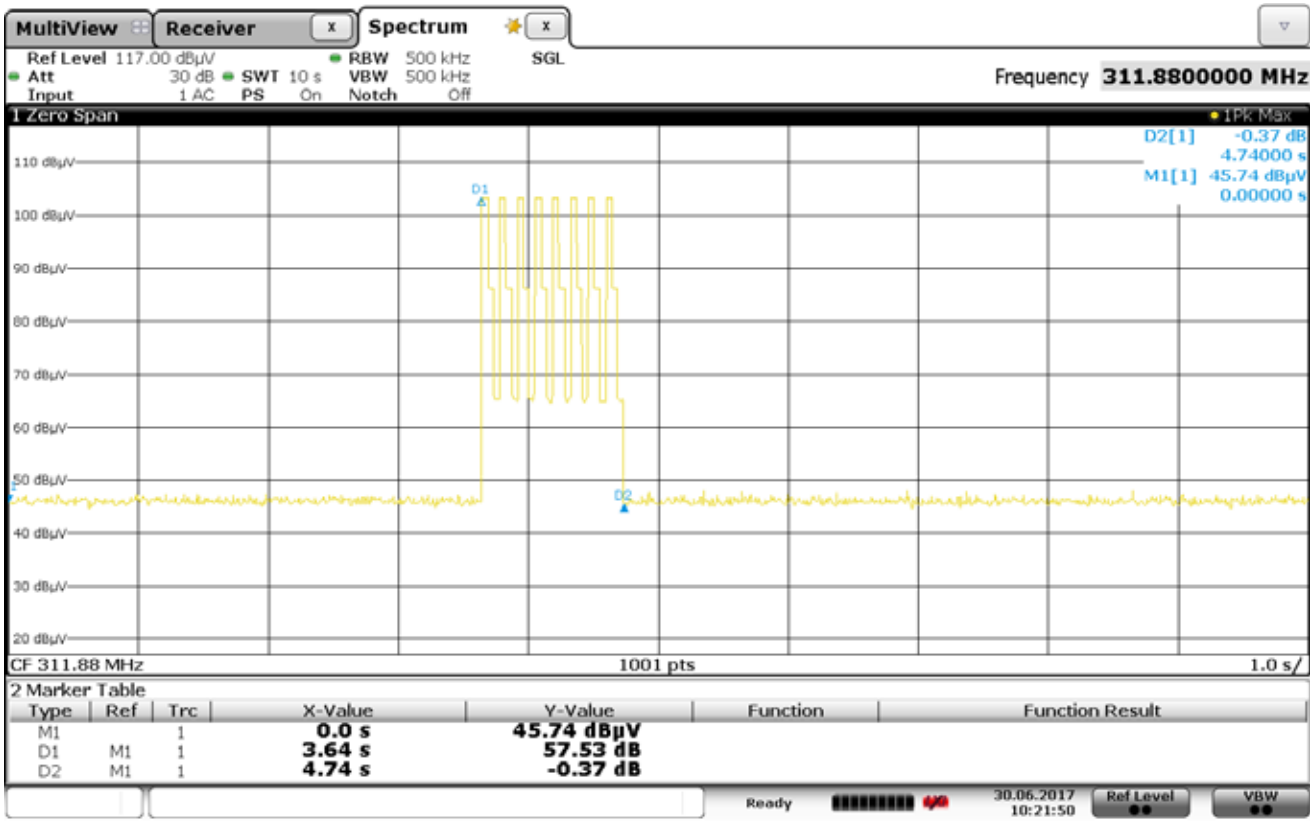
Test Setup for Radiated Emissions, 1-4.5GHz – Vertical Polarization



DEACTIVATION TIME

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx

NOTES: 5s Deactivation Time test



Date: 30.JUN.2017 10:21:51

TRANSMISSION TIME

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx

NOTES: Initial full power transmission burst (1.10s)

Date: 30.JUN.2017 16:35:51

TRANSMISSION TIME

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx

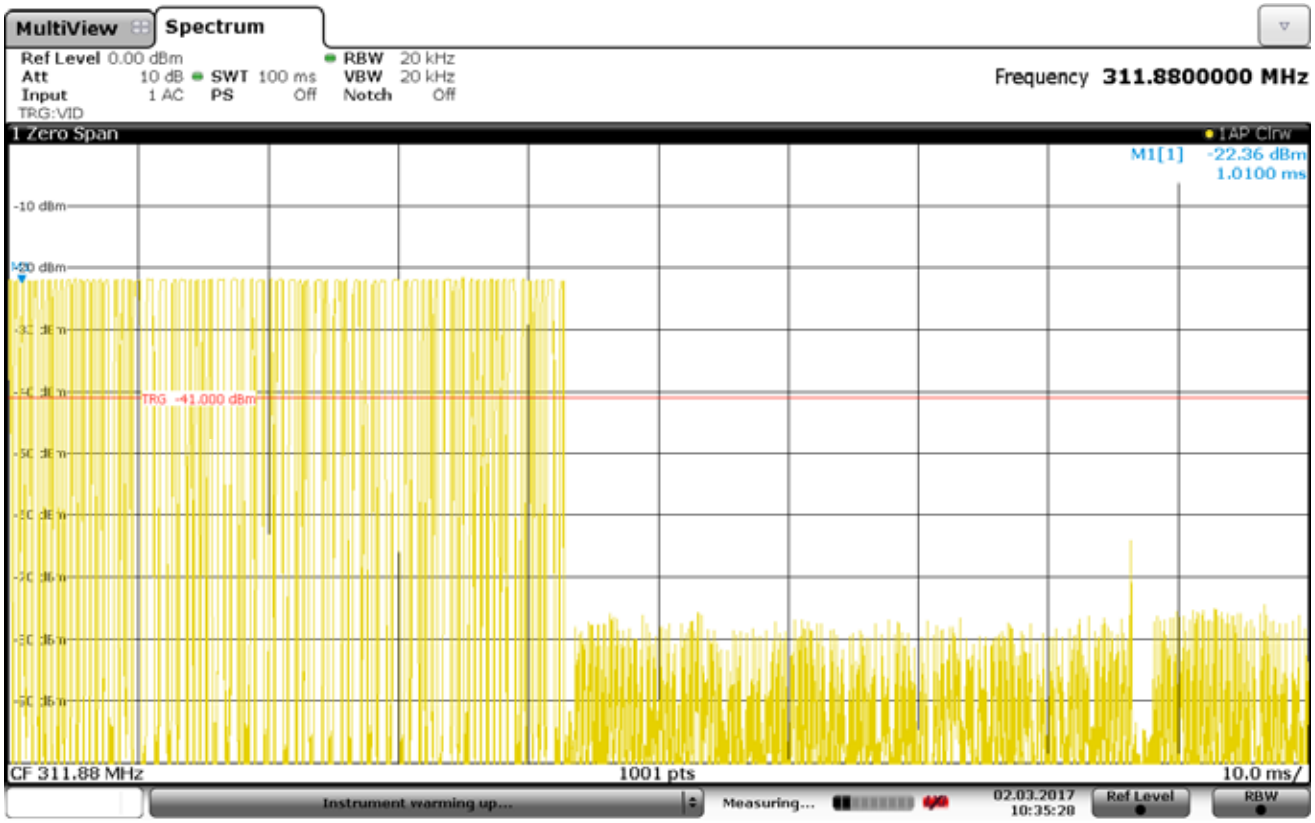
NOTES: Periodic transmission burst is 975.0ms

Date: 30.JUN.2017 16:18:07

TRANSMISSION TIME

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx

NOTES: 2 periodic transmission bursts in one hour at 975.0ms each, for a total of 1.950s.

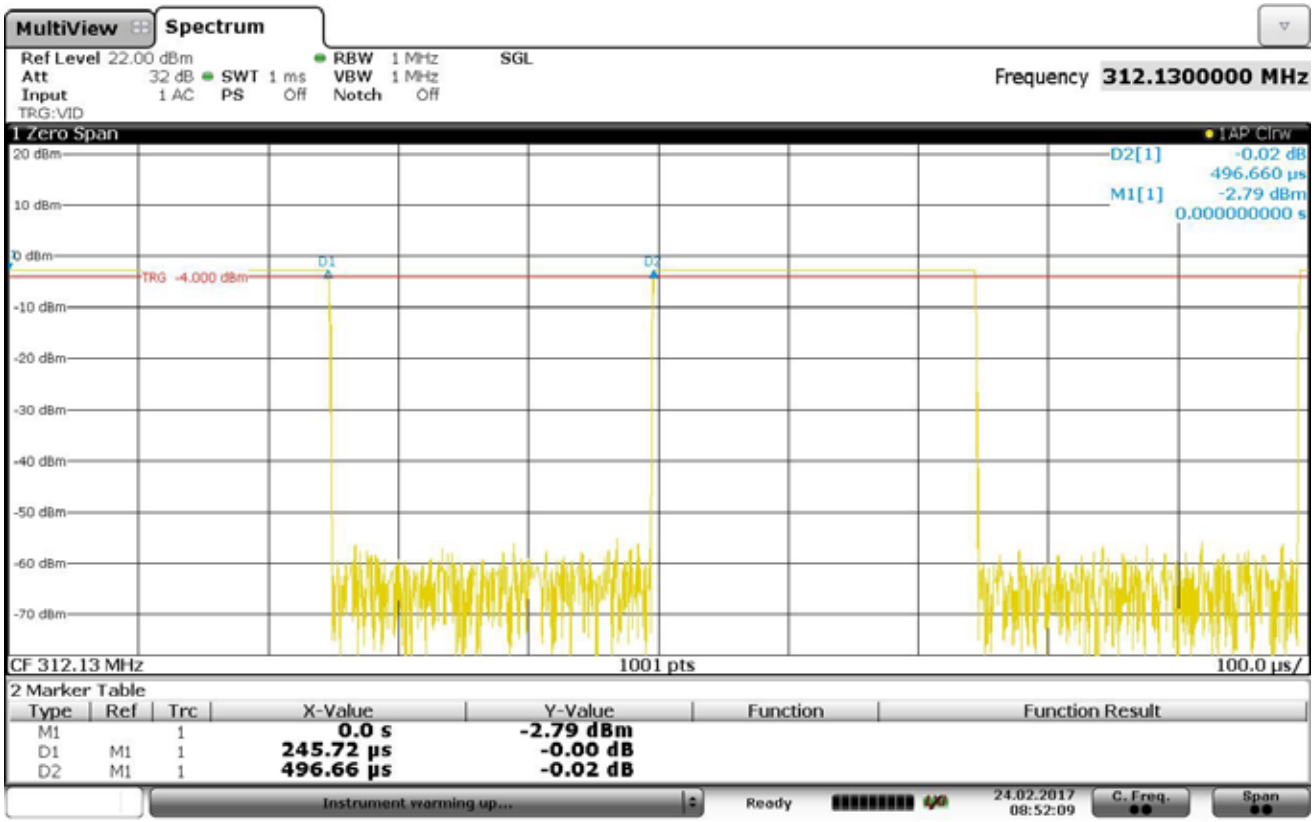


Date: 2.MAR.2017 10:35:28

DUTY CYCLE - # OF PULSES

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 311.88MHz

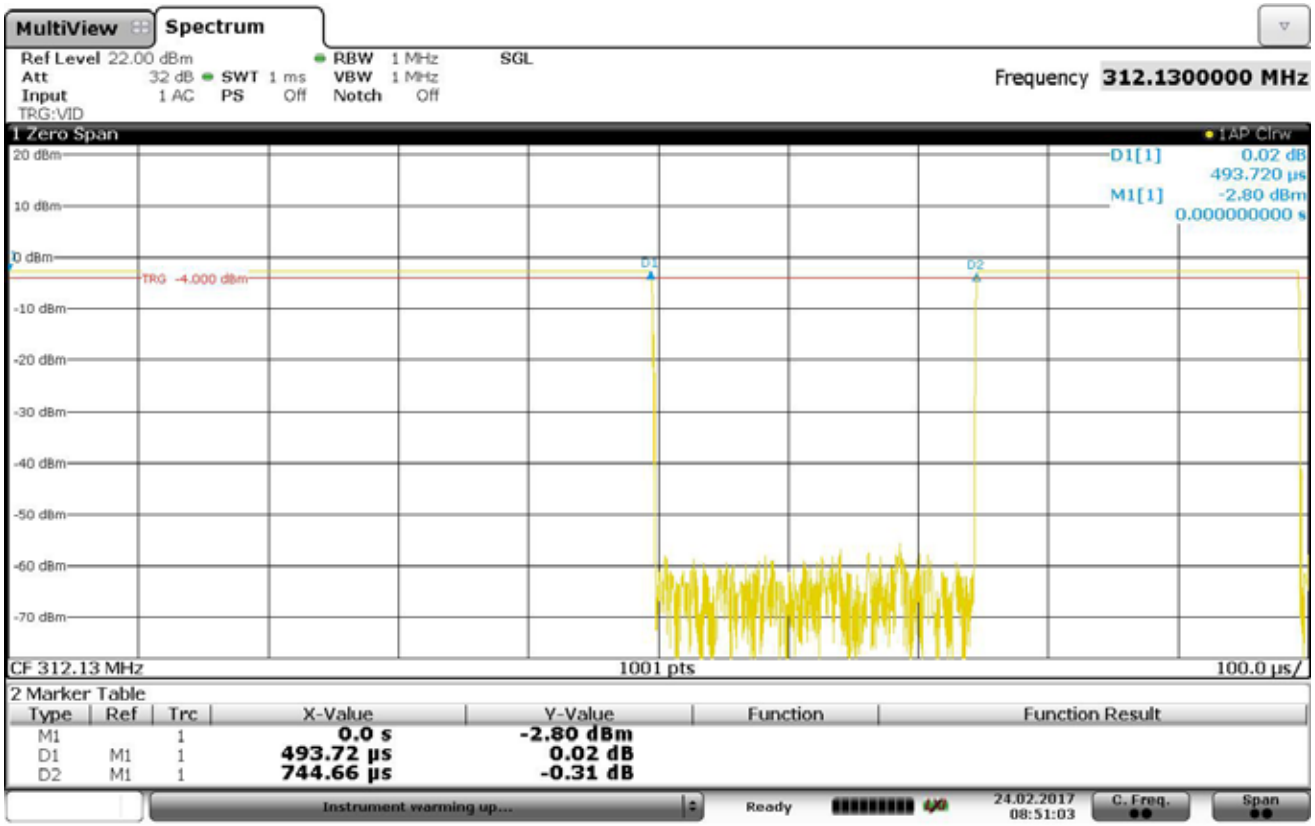
NOTES



DUTY CYCLE – NARROW PULSE

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 311.88MHz

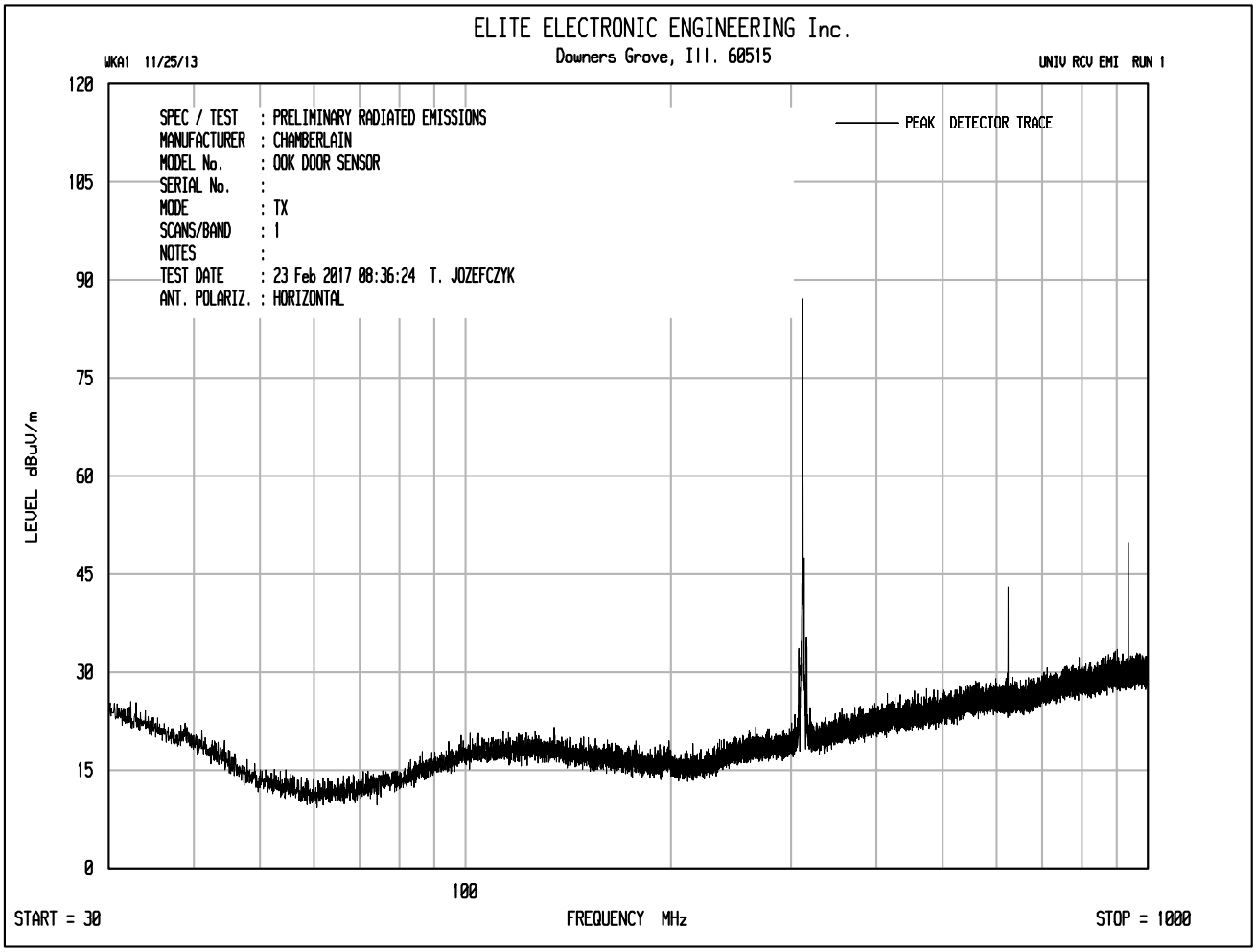
NOTES

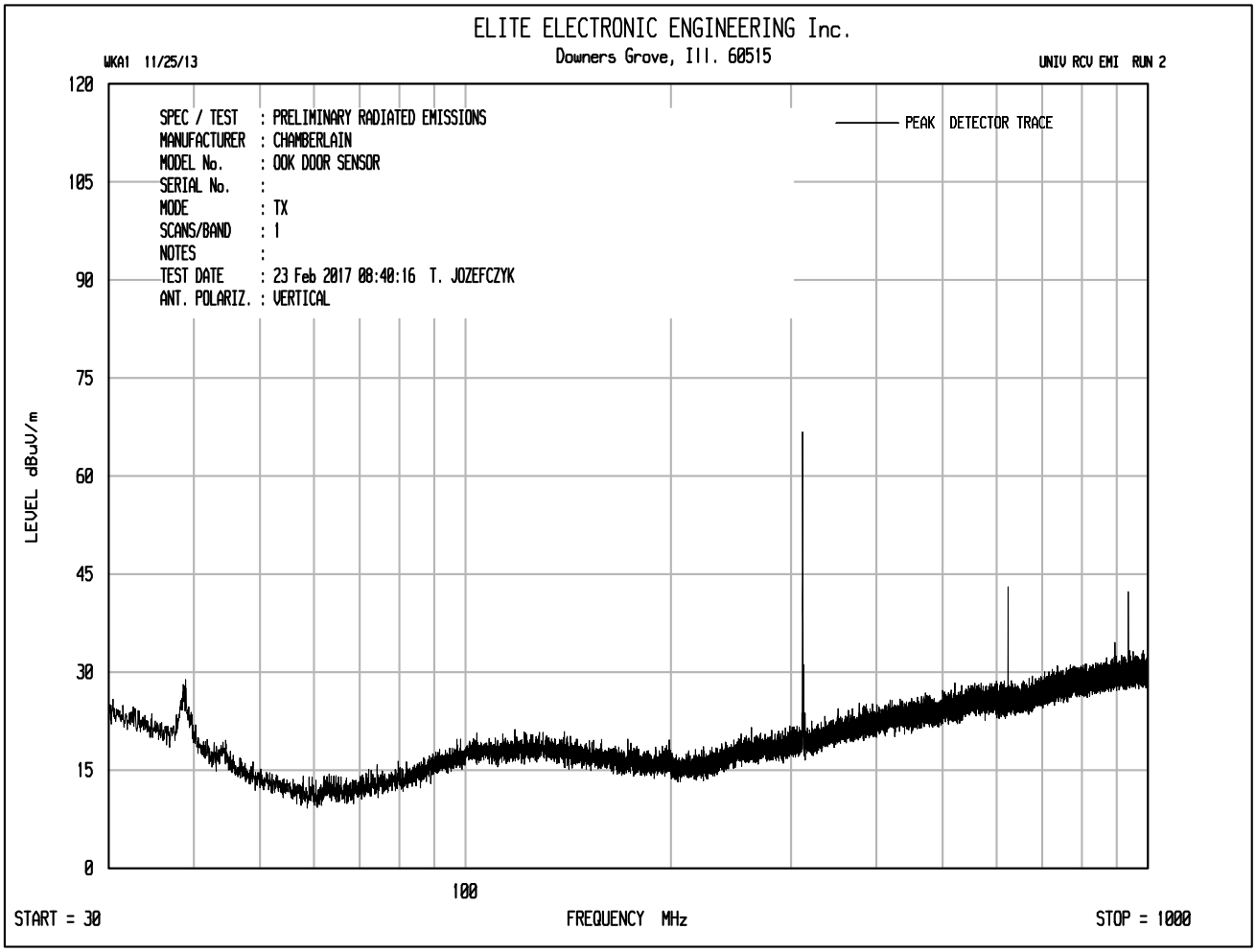


DUTY CYCLE – WIDE PULSE

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 311.88MHz

NOTES


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 1
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 08:36:24 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000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Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 2
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 08:40:16 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
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105
90
75
60
45
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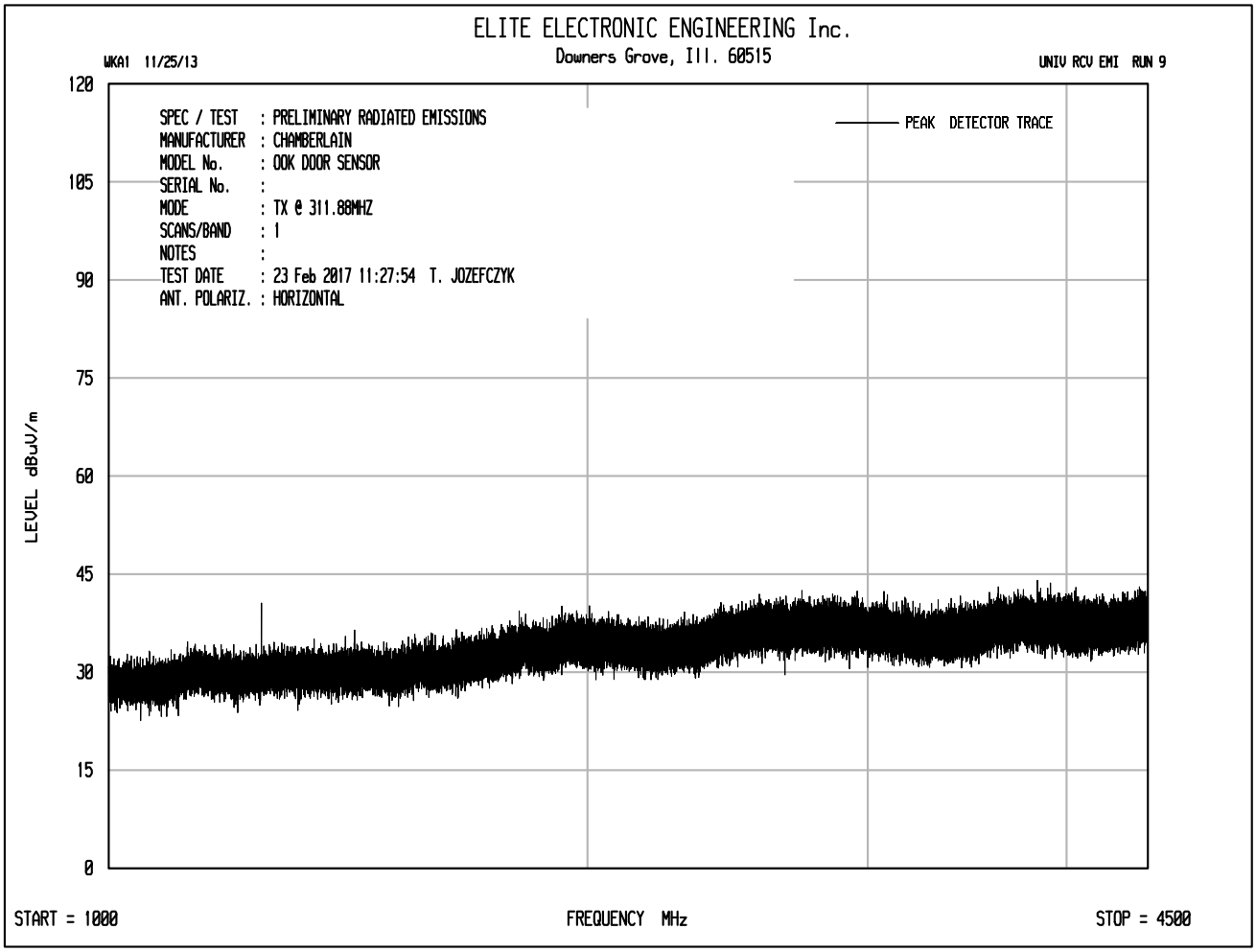
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 9
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 311.88MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 11:27:54 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
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75
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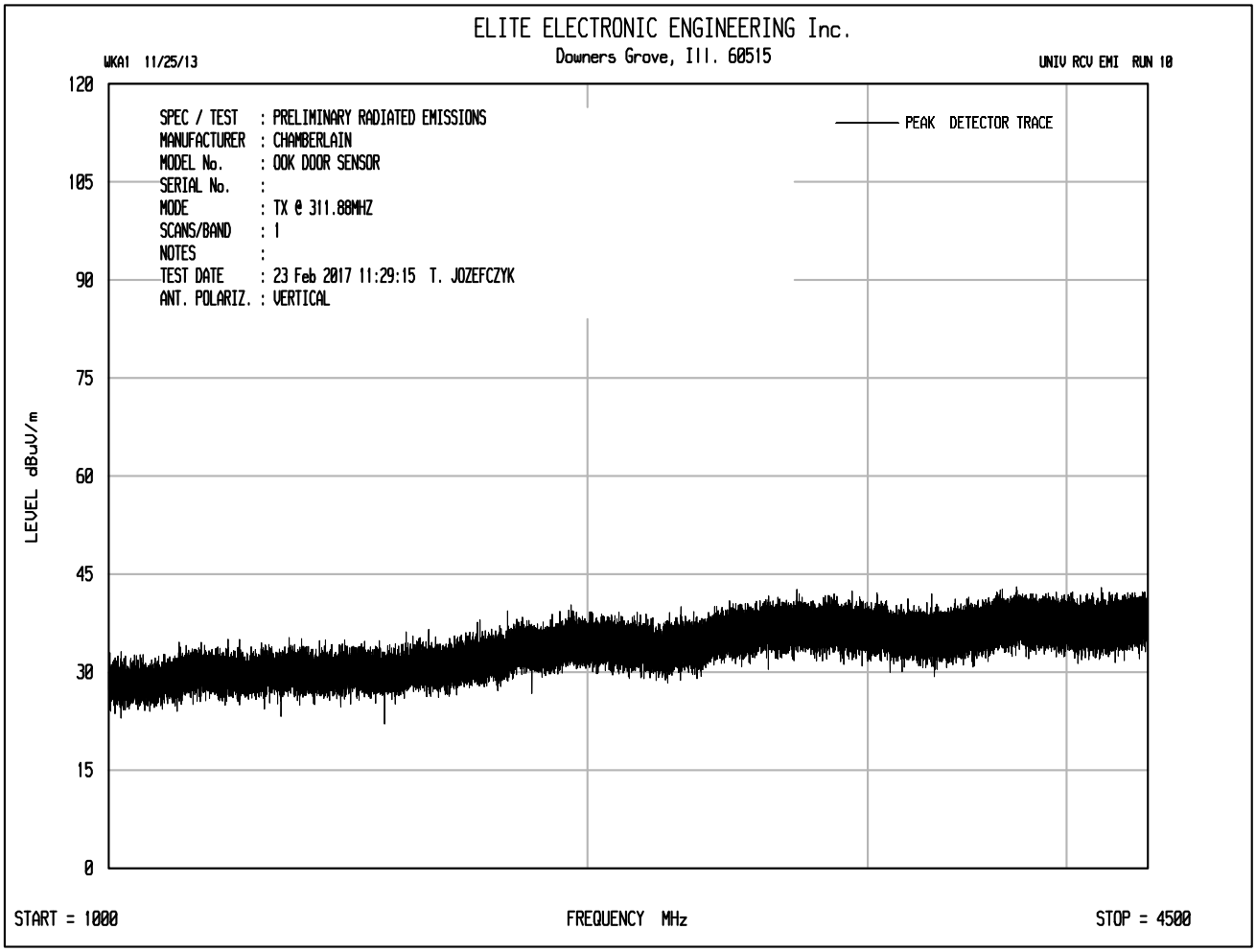
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500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Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 10
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 311.88MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 11:29:15 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
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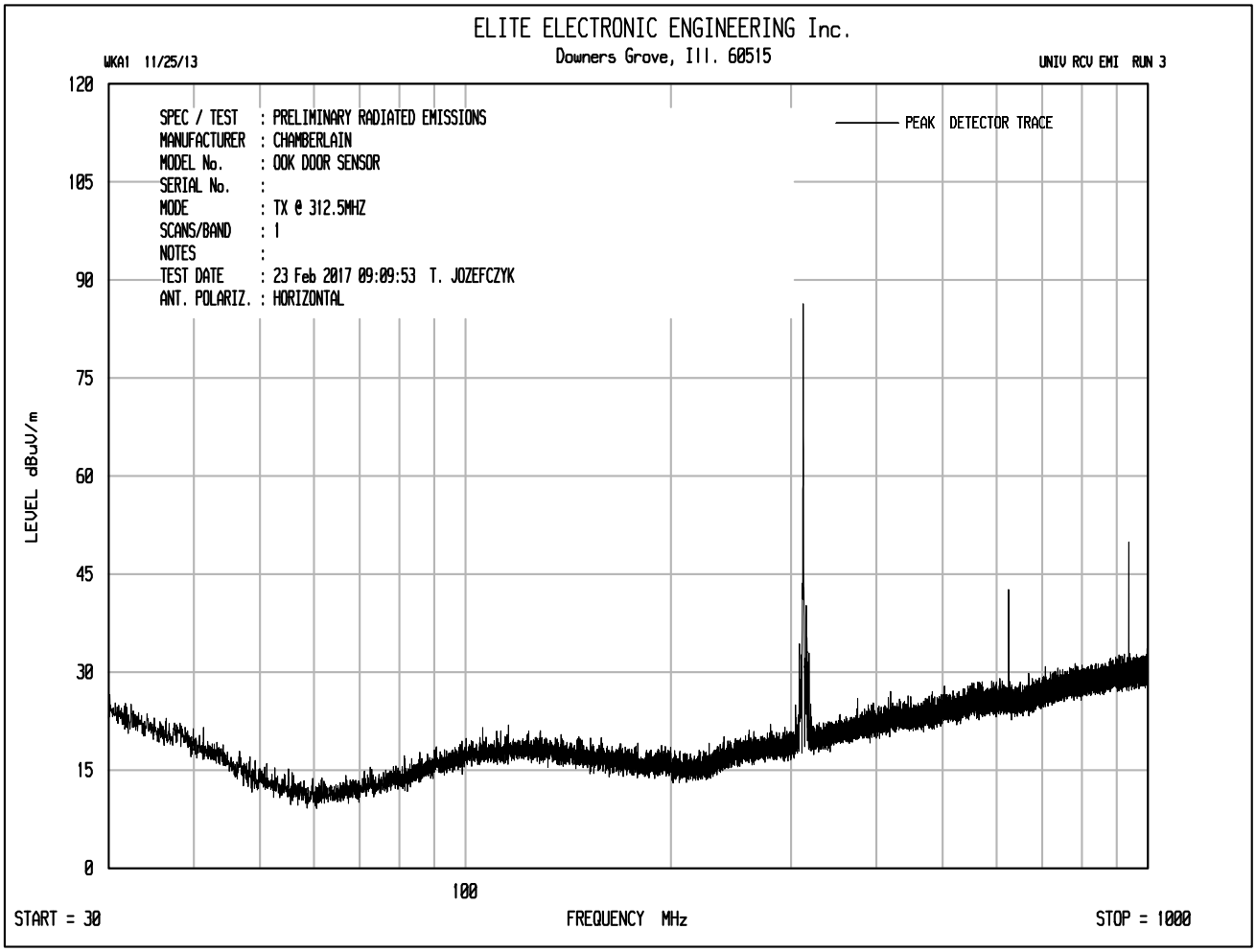
FREQUENCY MHz
STOP = 4500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Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 3
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 312.5MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 09:09:53 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
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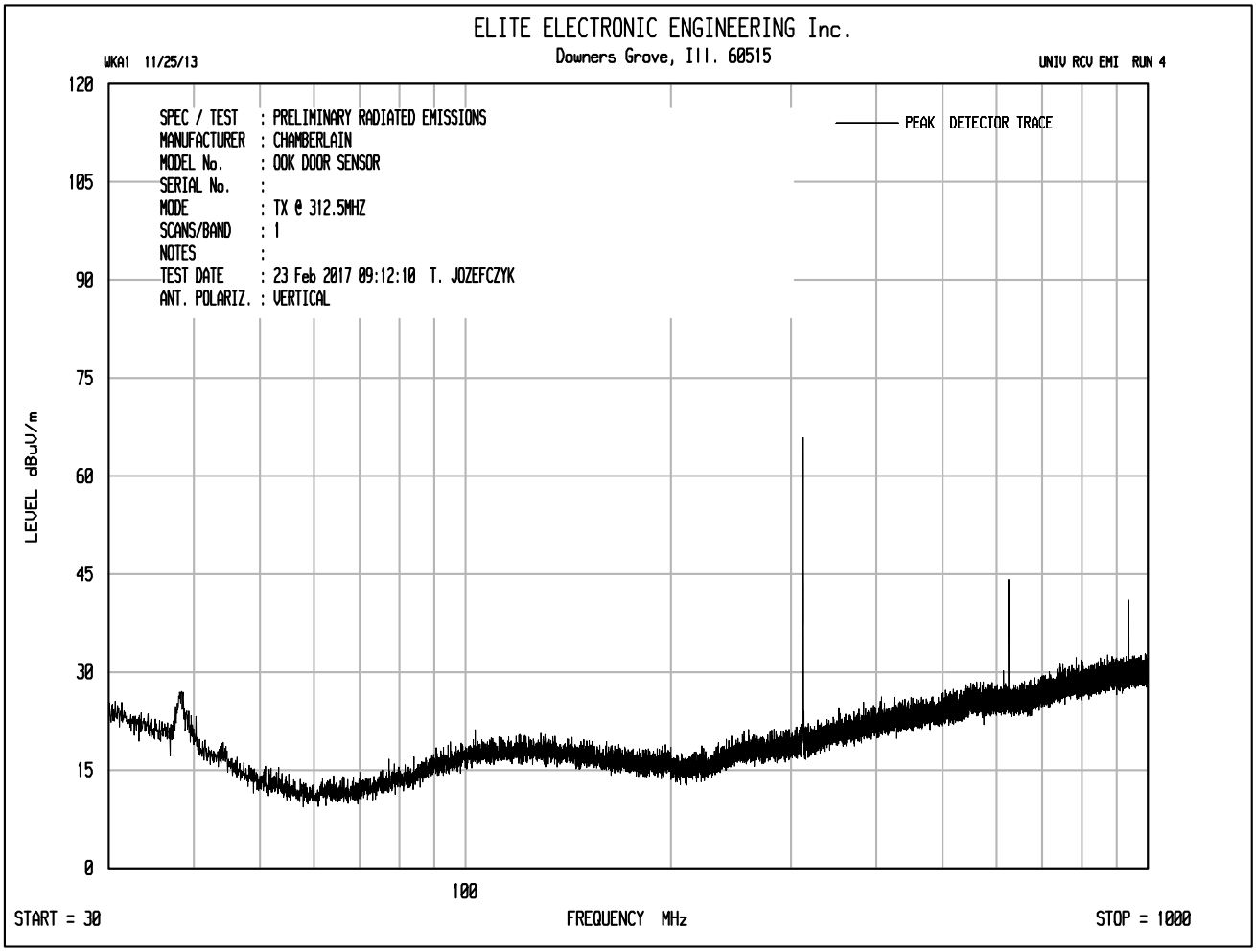
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000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Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 4
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MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 312.5MHZ
SCANS/BAND : 1
NOTES :
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PEAK DETECTOR TRACE
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75
60
45
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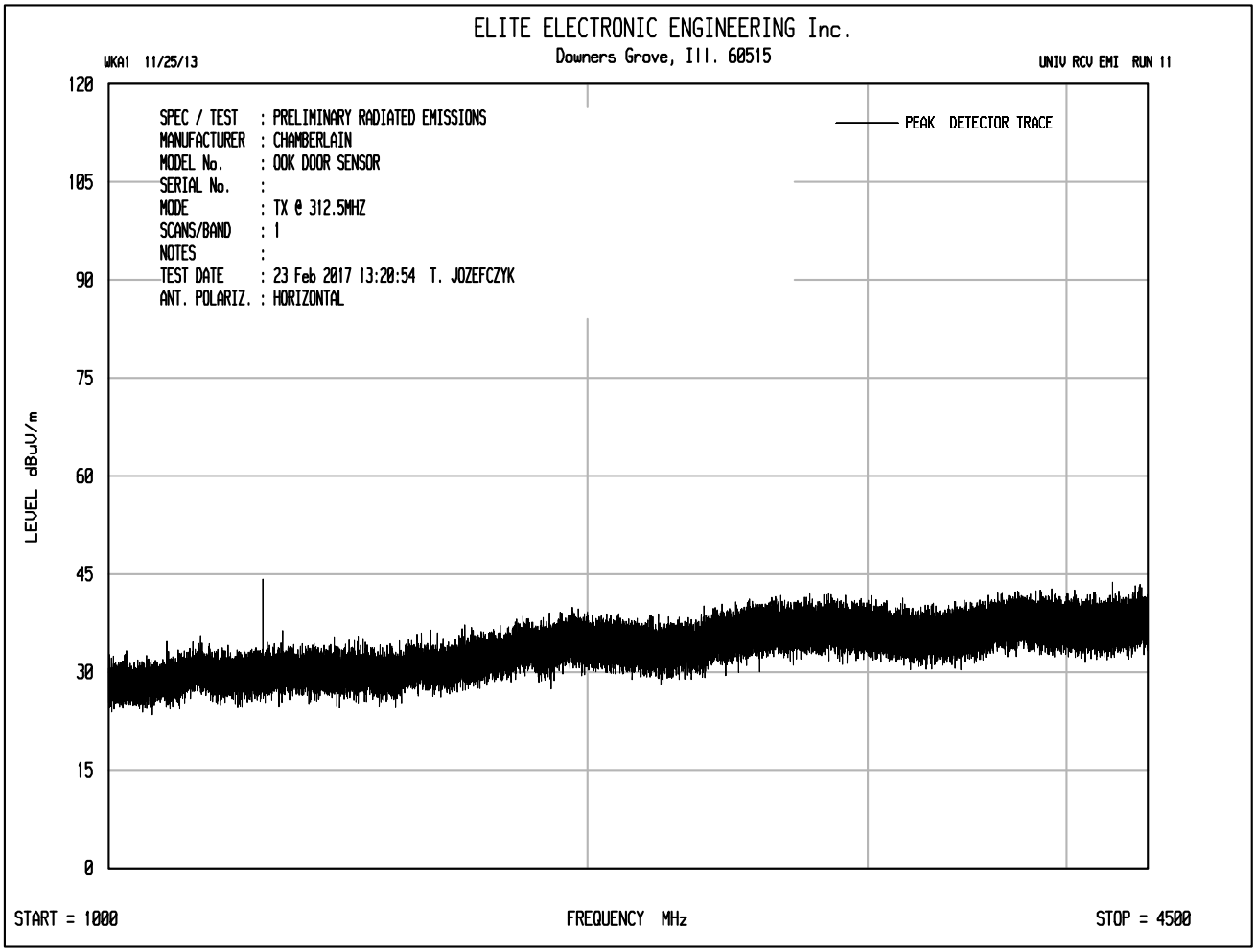
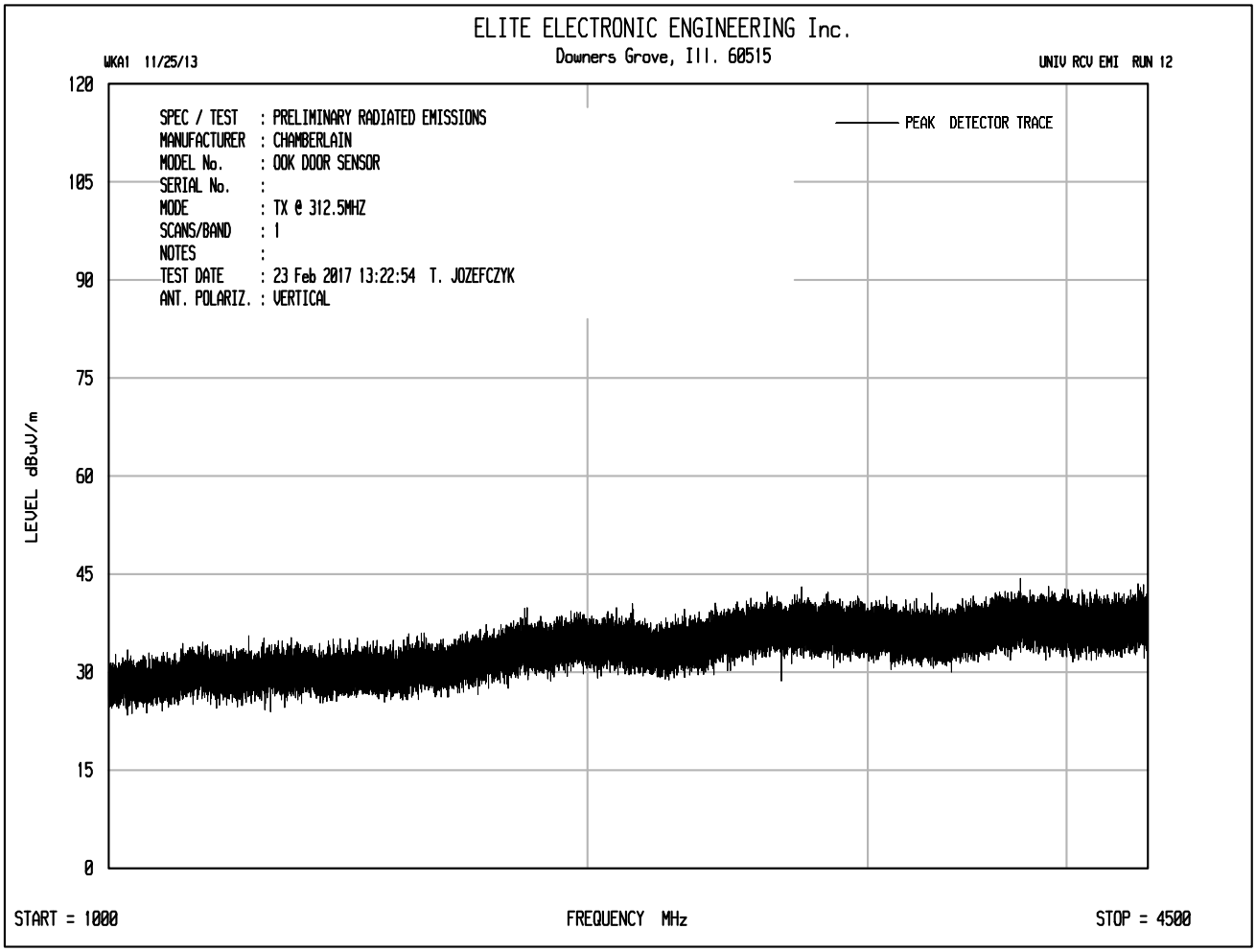
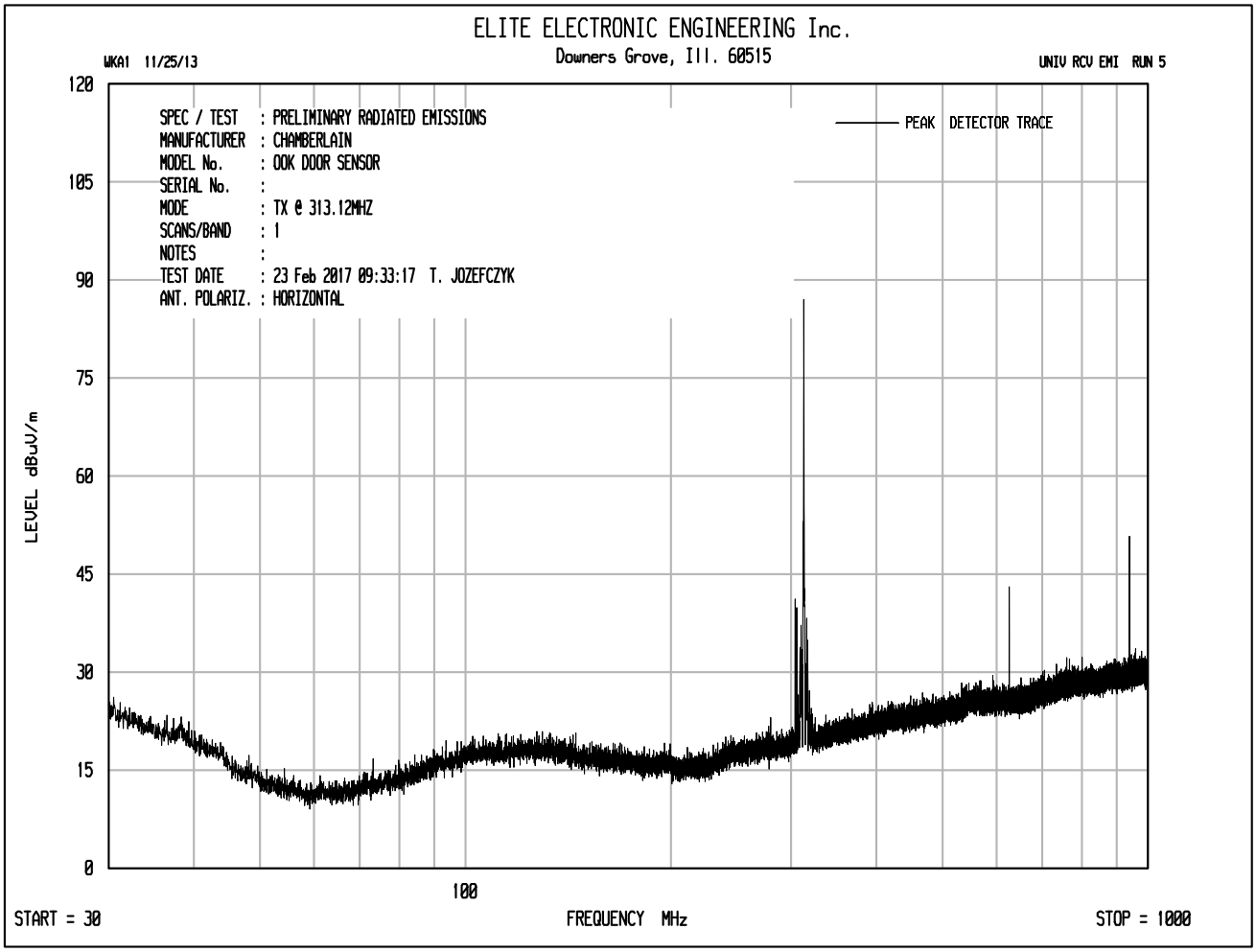
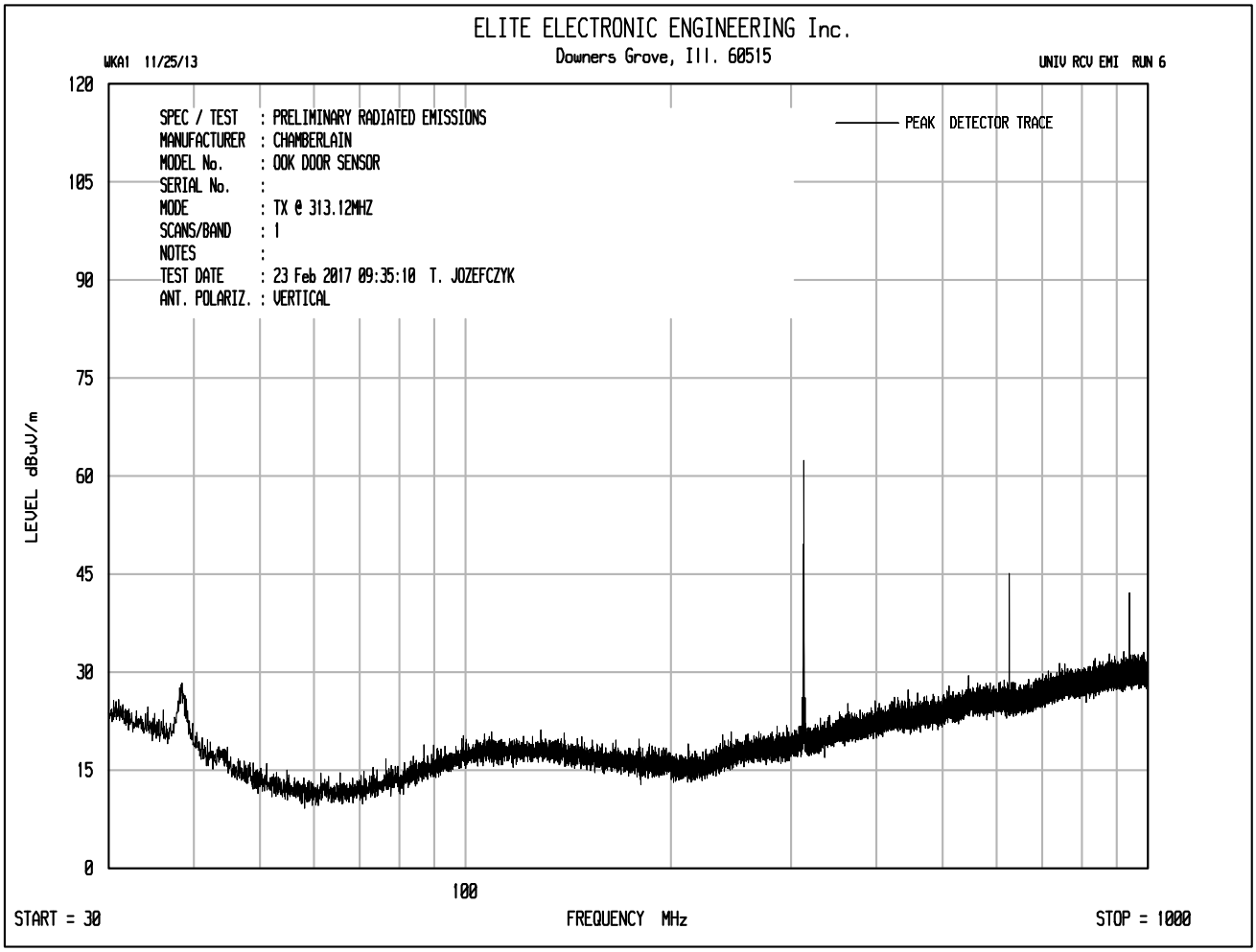
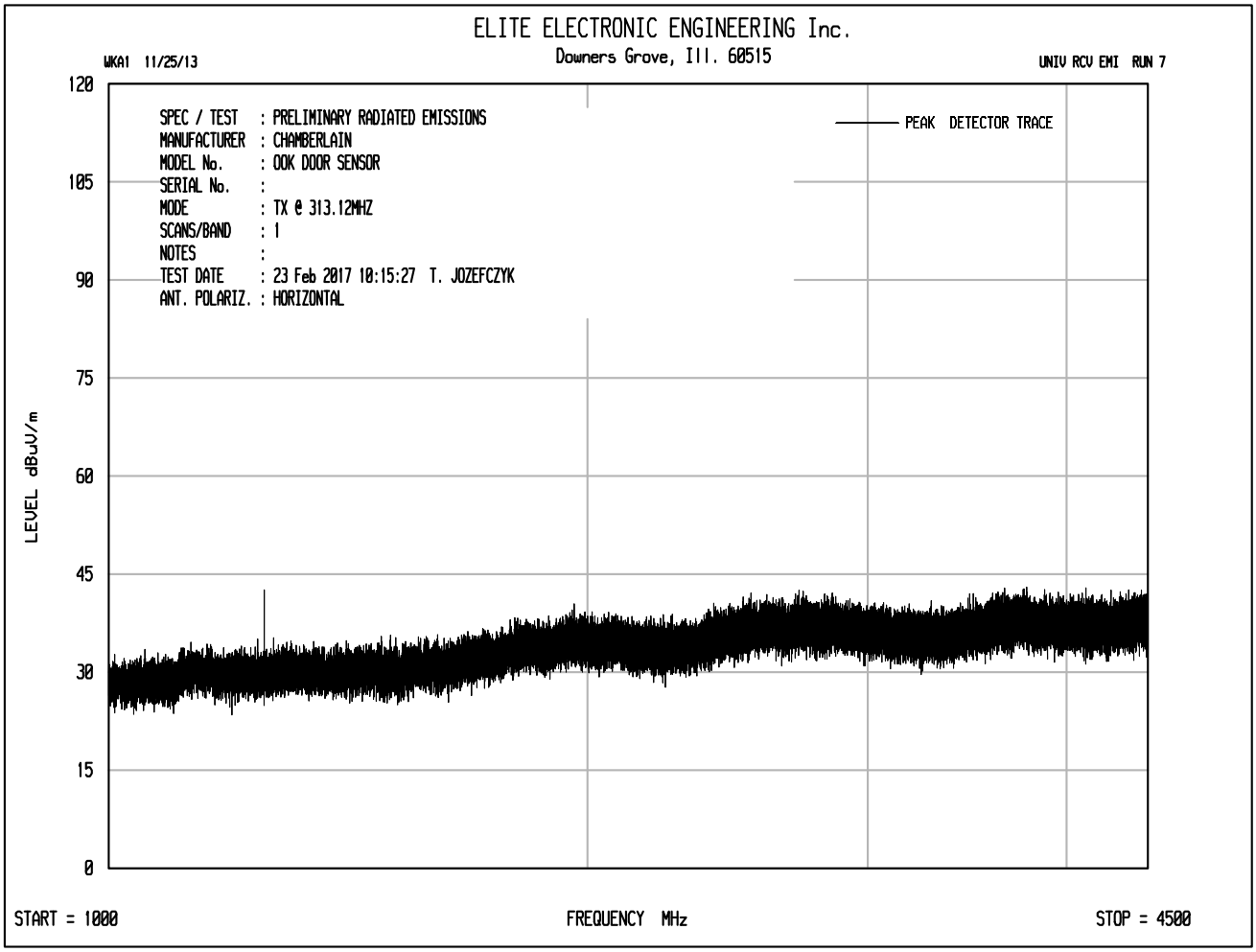
0
100
START = 30
FREQUENCY MHz
STOP = 1000

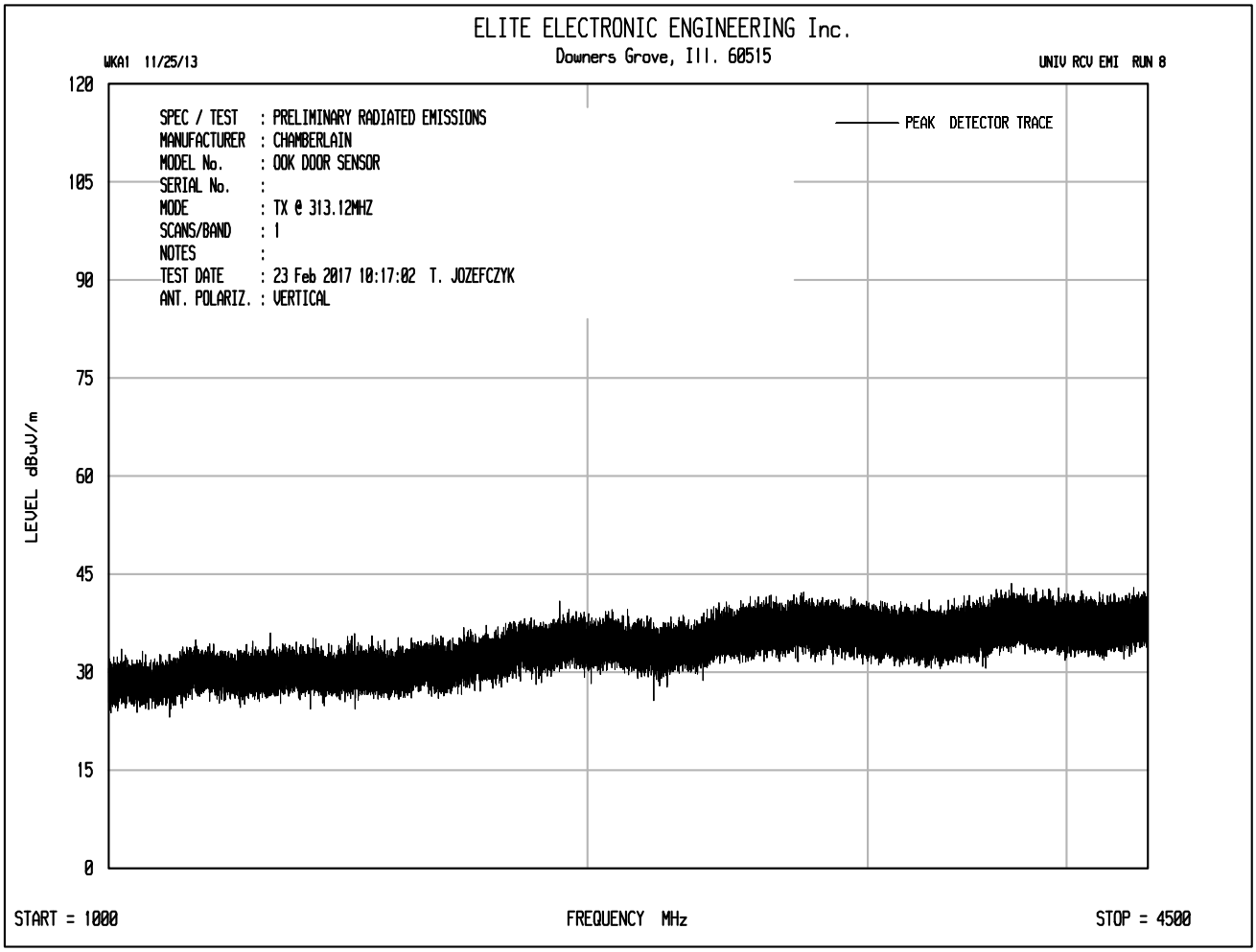

ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 11
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 312.5MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 13:20:54 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 12
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 312.5MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 13:22:54 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 5
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 313.12MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 09:33:17 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 6
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 313.12MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 09:35:10 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
100
START = 30
FREQUENCY MHz
STOP = 1000


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 7
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 313.12MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 10:15:27 T. JOZEFCZYK
ANT. POLARIZ. : HORIZONTAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500


ELITE ELECTRONIC ENGINEERING Inc.
Downers Grove, Ill. 60515
WKA1 11/25/13
UNIV RCV EMI RUN 8
SPEC / TEST : PRELIMINARY RADIATED EMISSIONS
MANUFACTURER : CHAMBERLAIN
MODEL No. : OOK DOOR SENSOR
SERIAL No. :
MODE : TX @ 313.12MHZ
SCANS/BAND : 1
NOTES :
TEST DATE : 23 Feb 2017 10:17:02 T. JOZEFCZYK
ANT. POLARIZ. : VERTICAL
PEAK DETECTOR TRACE
LEVEL dBuV/m
120
105
90
75
60
45
30
15
0
START = 1000
FREQUENCY MHz
STOP = 4500

MANUFACTURER Chamberlain Group, Inc.
EUT OOK Door Sensor
SPECIFICATION FCC 15 C, Section 15.231
TEST Preliminary Radiated Emissions
MODE Tx – 311.88MHz
DATE TESTED 02/23/2017

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
311.880	H	66.1	1.2	19.3	0.0	-13.5	73.1	4538.6	5911.7	-2.3
311.880	V	48.4	1.2	19.3	0.0	-13.5	55.4	588.7	5911.7	-20.0
623.760	H	30.3	1.7	24.7	0.0	-13.5	43.2	144.0	591.2	-12.3
623.760	V	25.7	1.7	24.7	0.0	-13.5	38.6	85.3	591.2	-16.8
935.640	H	28.2	2.1	26.5	0.0	-13.5	43.3	146.3	591.2	-12.1
935.640	V	22.4	2.1	26.5	0.0	-13.5	37.4	74.5	591.2	-18.0
1247.520	H	26.6	2.4	28.9	0.0	-13.5	44.4	166.7	591.2	-11.0
1247.520	V	27.0	2.4	28.9	0.0	-13.5	44.9	175.0	591.2	-10.6
1559.400	H	27.7	2.7	28.3	0.0	-13.5	45.2	181.0	500.0	-8.8
1559.400	V	27.0	2.7	28.3	0.0	-13.5	44.5	168.1	500.0	-9.5
1871.280	H	26.5	3.0	31.0	0.0	-13.5	46.9	221.1	591.2	-8.5
1871.280	V	26.3	3.0	31.0	0.0	-13.5	46.7	216.6	591.2	-8.7
2183.160	H	28.3	3.2	31.7	0.0	-13.5	49.8	307.3	591.2	-5.7
2183.160	V	28.2	3.2	31.7	0.0	-13.5	49.6	303.1	591.2	-5.8
2495.040	H	27.1	3.5	32.2	0.0	-13.5	49.3	292.0	500.0	-4.7
2495.040	V	26.7	3.5	32.2	0.0	-13.5	49.0	280.5	500.0	-5.0
2806.920	H	27.7	3.8	32.6	0.0	-13.5	50.5	335.0	500.0	-3.5
2806.920	V	27.7	3.8	32.6	0.0	-13.5	50.5	335.7	500.0	-3.5
3118.800	H	27.1	4.0	32.9	0.0	-13.5	50.5	335.4	591.2	-4.9
3118.800	V	26.4	4.0	32.9	0.0	-13.5	49.7	306.6	591.2	-5.7

Tested By: _____
Tylar Jozefczyk

MANUFACTURER Chamberlain Group, Inc.
EUT OOK Door Sensor
SPECIFICATION FCC 15 C, Section 15.231
TEST Preliminary Radiated Emissions
MODE Tx – 312.5MHz
DATE TESTED 02/23/2017

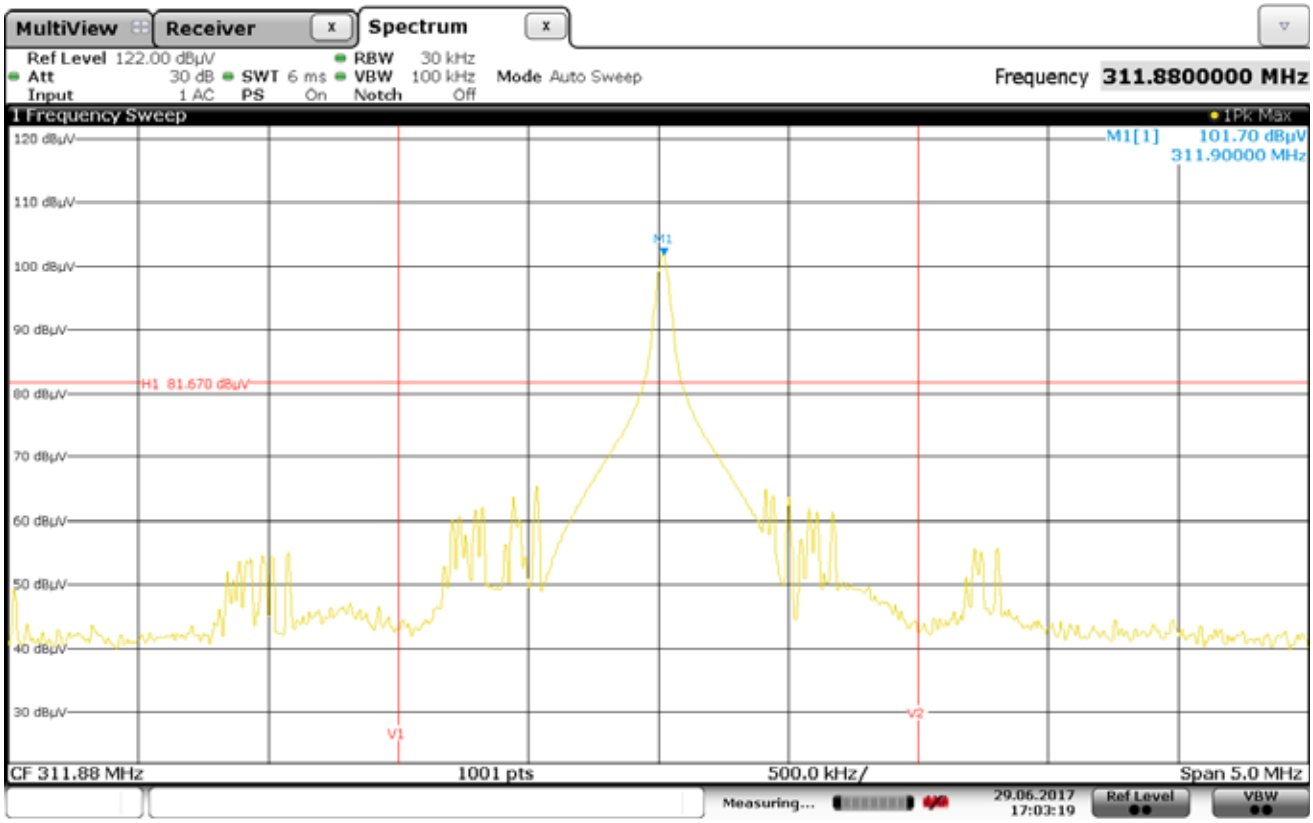
Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
312.500	H	66.2	1.2	19.3	0.0	-13.5	73.2	4575.9	5937.5	-2.3
312.500	V	48.7	1.2	19.3	0.0	-13.5	55.7	612.3	5937.5	-19.7
625.000	H	31.1	1.7	24.7	0.0	-13.5	44.0	158.7	593.7	-11.5
625.000	V	26.2	1.7	24.7	0.0	-13.5	39.1	90.3	593.7	-16.4
937.500	H	26.6	2.1	26.5	0.0	-13.5	41.7	121.9	593.7	-13.8
937.500	V	22.0	2.1	26.5	0.0	-13.5	37.1	71.3	593.7	-18.4
1250.000	H	26.7	2.4	28.9	0.0	-13.5	44.5	168.4	593.7	-10.9
1250.000	V	25.8	2.4	28.9	0.0	-13.5	43.6	151.5	593.7	-11.9
1562.500	H	16.0	2.7	28.3	0.0	-13.5	33.5	47.2	500.0	-20.5
1562.500	V	15.8	2.7	28.3	0.0	-13.5	33.3	46.4	500.0	-20.6
1875.000	H	14.8	3.0	31.0	0.0	-13.5	35.3	57.9	593.7	-20.2
1875.000	V	15.0	3.0	31.0	0.0	-13.5	35.4	59.0	593.7	-20.1
2187.500	H	15.7	3.2	31.7	0.0	-13.5	37.2	72.4	593.7	-18.3
2187.500	V	15.0	3.2	31.7	0.0	-13.5	36.5	66.6	593.7	-19.0
2500.000	H	15.8	3.5	32.2	0.0	-13.5	38.0	79.5	500.0	-16.0
2500.000	V	15.5	3.5	32.2	0.0	-13.5	37.7	76.9	500.0	-16.3
2812.500	H	15.8	3.8	32.6	0.0	-13.5	38.7	86.1	500.0	-15.3
2812.500	V	16.2	3.8	32.6	0.0	-13.5	39.0	89.2	500.0	-15.0
3125.000	H	15.1	4.0	32.9	0.0	-13.5	38.5	84.4	593.7	-16.9
3125.000	V	15.0	4.0	32.9	0.0	-13.5	38.4	83.0	593.7	-17.1

Tested By: _____
Tylar Jozefczyk

MANUFACTURER Chamberlain Group, Inc.
EUT OOK Door Sensor
SPECIFICATION FCC 15 C, Section 15.231
TEST Preliminary Radiated Emissions
MODE Tx – 313.12MHz
DATE TESTED 02/23/2017

Freq. (MHz)	Ant Pol	Meter Reading (dBuV)	CBL Fac (dB)	Ant Fac (dB)	Pre Amp (dB)	Duty Cycle (dB)	Total (dBuV/m)	Total (uV/m)	Limit (uV/m)	Margin (dB)
313.120	H	66.2	1.2	19.3	0.0	-13.5	73.2	4581.8	5963.3	-2.3
313.120	V	48.8	1.2	19.3	0.0	-13.5	55.8	619.5	5963.3	-19.7
626.240	H	31.1	1.7	24.7	0.0	-13.5	44.0	159.4	596.3	-11.5
626.240	V	26.8	1.7	24.7	0.0	-13.5	39.7	96.2	596.3	-15.8
939.360	H	27.3	2.1	26.5	0.0	-13.5	42.4	131.7	596.3	-13.1
939.360	V	22.4	2.1	26.5	0.0	-13.5	37.5	75.1	596.3	-18.0
1252.480	H	26.7	2.4	28.9	0.0	-13.5	44.5	167.4	596.3	-11.0
1252.480	V	26.4	2.4	28.9	0.0	-13.5	44.2	161.6	596.3	-11.3
1565.600	H	28.0	2.7	28.3	0.0	-13.5	45.6	190.5	500.0	-8.4
1565.600	V	28.1	2.7	28.3	0.0	-13.5	45.6	191.6	500.0	-8.3
1878.720	H	26.2	3.0	31.0	0.0	-13.5	46.7	216.4	596.3	-8.8
1878.720	V	26.7	3.0	31.0	0.0	-13.5	47.2	228.7	596.3	-8.3
2191.840	H	28.5	3.3	31.7	0.0	-13.5	50.0	315.9	596.3	-5.5
2191.840	V	28.1	3.3	31.7	0.0	-13.5	49.6	301.0	596.3	-5.9
2504.960	H	27.7	3.5	32.2	0.0	-13.5	49.9	314.2	596.3	-5.6
2504.960	V	27.0	3.5	32.2	0.0	-13.5	49.2	289.5	596.3	-6.3
2818.080	H	27.7	3.8	32.6	0.0	-13.5	50.6	337.1	500.0	-3.4
2818.080	V	28.1	3.8	32.6	0.0	-13.5	50.9	351.8	500.0	-3.1
3131.200	H	27.1	4.0	32.9	0.0	-13.5	50.5	336.4	596.3	-5.0
3131.200	V	27.2	4.0	32.9	0.0	-13.5	50.6	339.2	596.3	-4.9

Tested By: _____
Tylar Jozefczyk

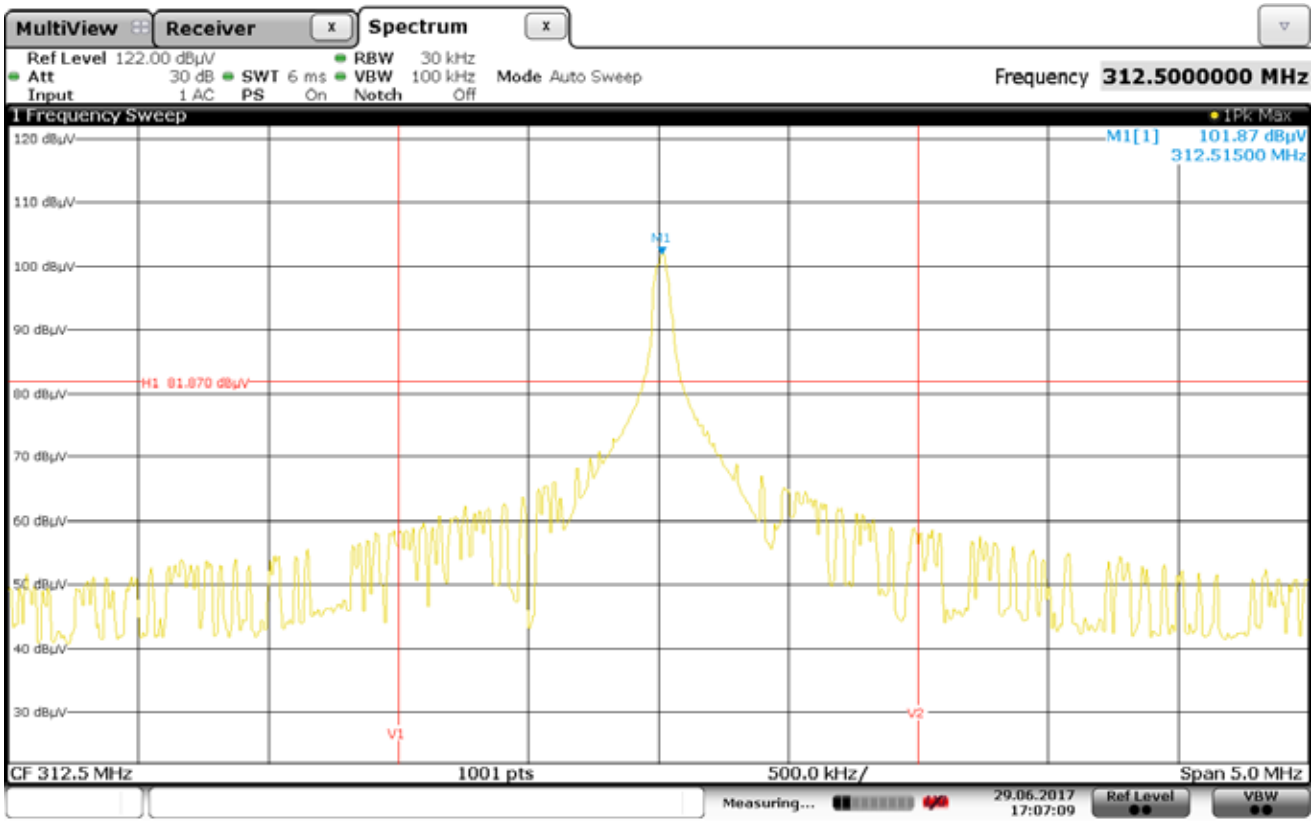


Date: 29.JUN.2017 17:03:19

OCCUPIED BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 311.88MHz

NOTES

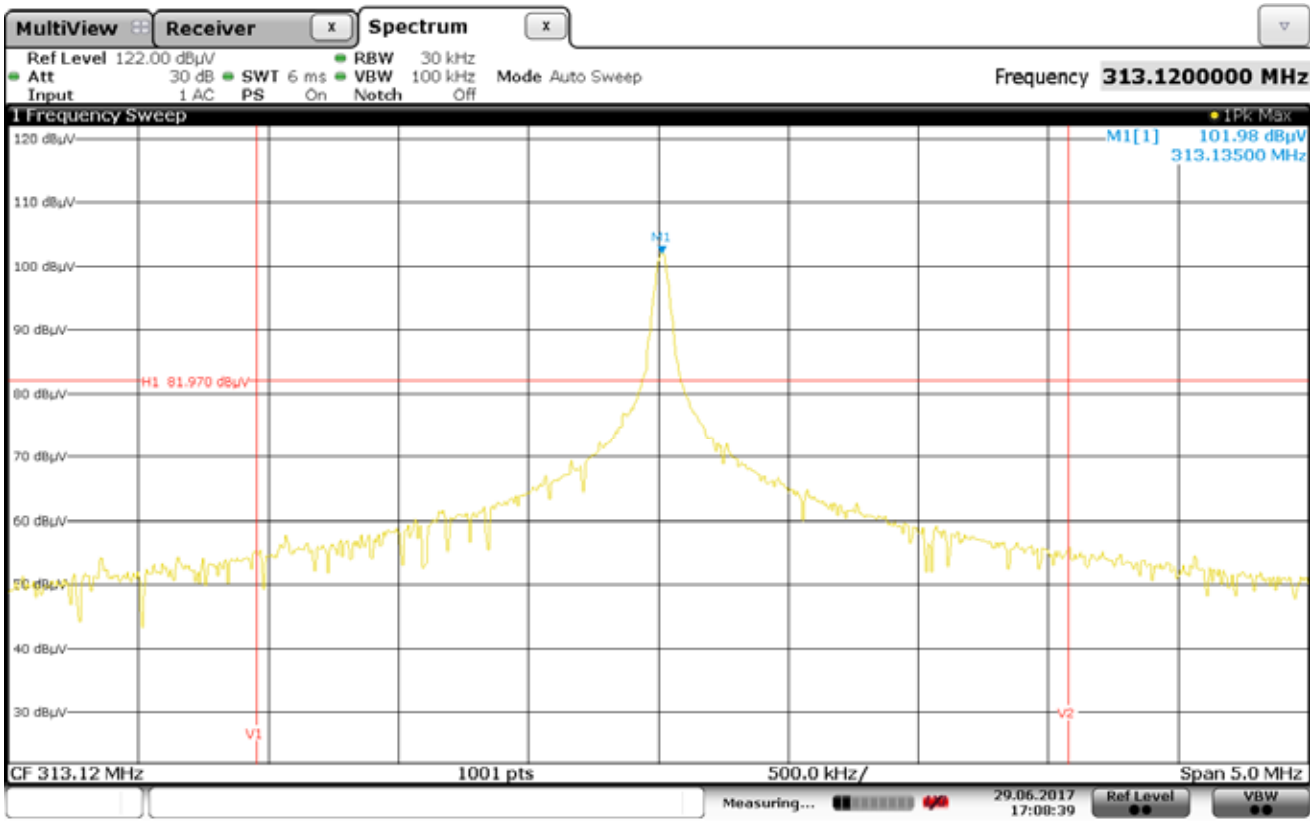


Date: 29.JUN.2017 17:07:09

OCCUPIED BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 312.5MHz

NOTES

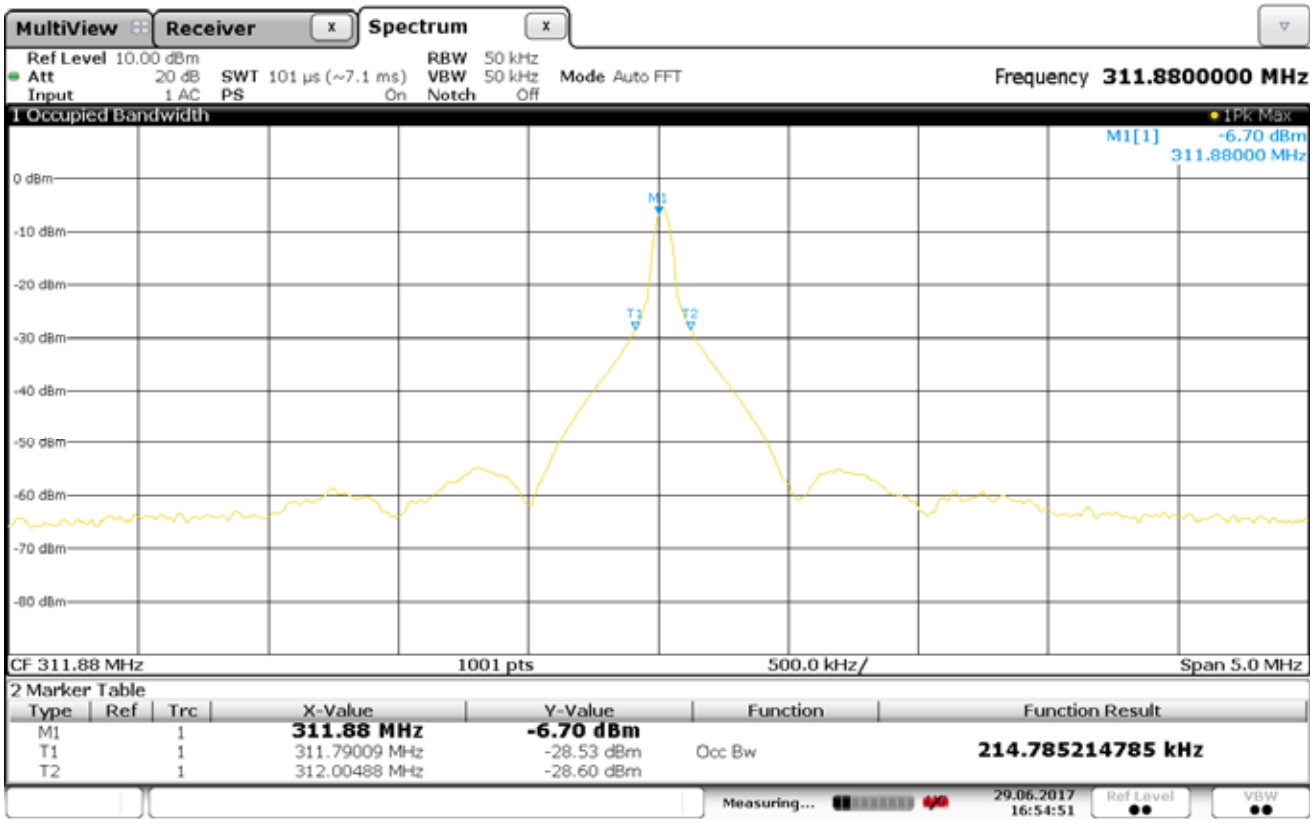


Date: 29.JUN.2017 17:08:40

OCCUPIED BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 313.12MHz

NOTES

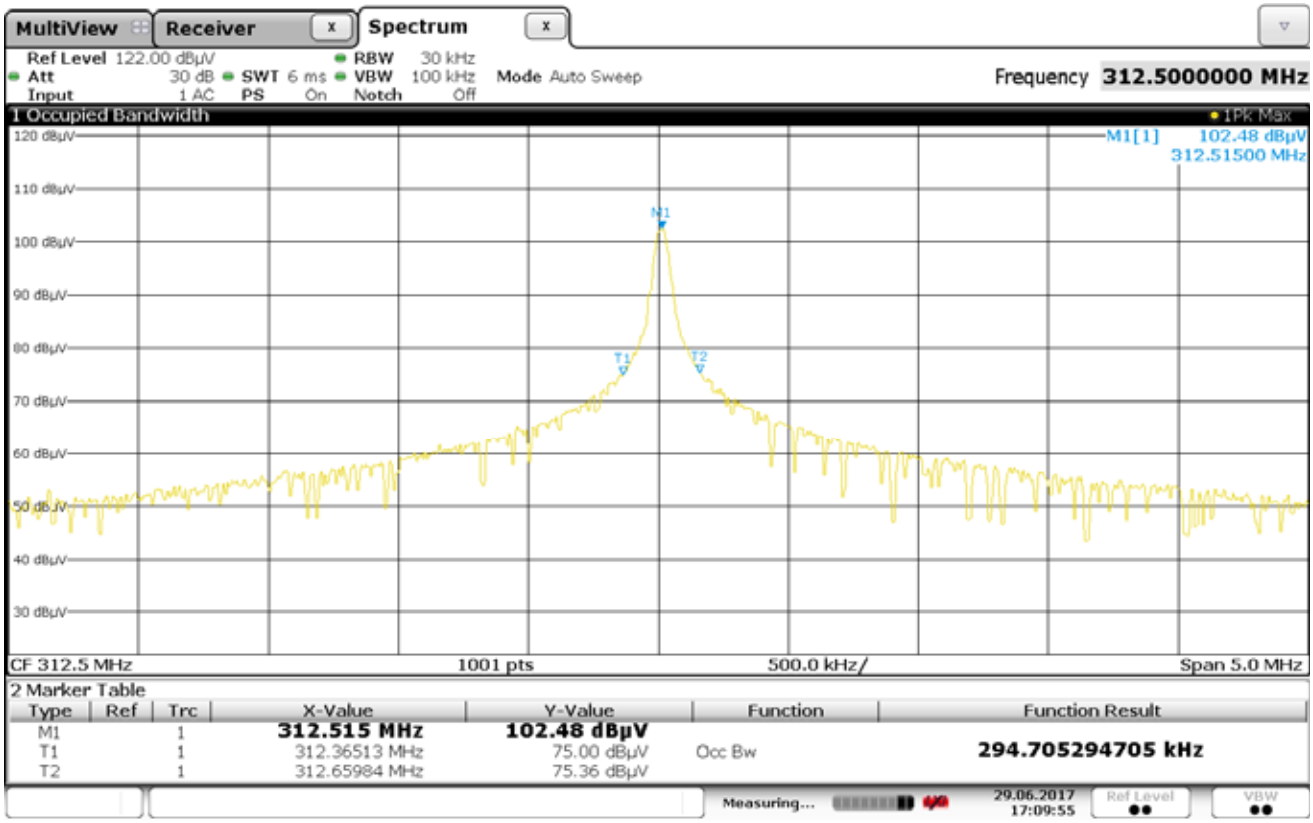


Date: 29.JUN.2017 16:54:51

99% BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 311.88MHz

NOTES

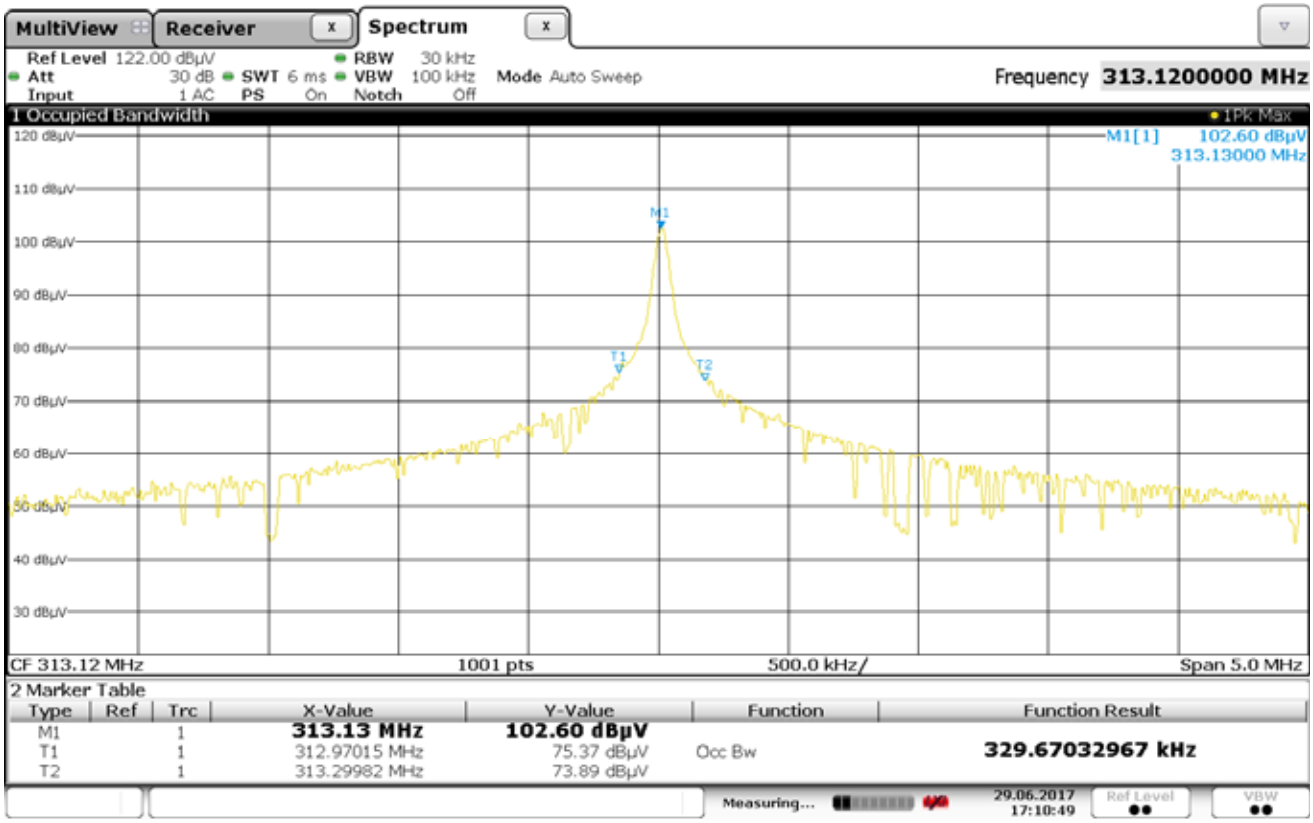


Date: 29.JUN.2017 17:09:56

99% BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 312.5MHz

NOTES



Date: 29.JUN.2017 17:10:50

99% BANDWIDTH

MANUFACTURER : Chamberlain Group, Inc.
TEST ITEM : OOK Door Sensor
TEST MODE : Tx – 313.12MHz

NOTES